Library
QC
770
U56
V.1
no.7

UNITED STATES ATOMIC ENERGY COMMISSION

Nuclear Science Abstracts

Vol. I No. 7
October 15, 1948

Issuing of these Abstracts does not constitute authority for declassification of any documents

Technical Information Division, Oak Ridge Operations
AEC, Oak Ridge, Tenn., 10-15-48--1300-A2061
Printed in U.S.A.
PRICE 30 CENTS

UNIVERSITY OF MICHIGAN LIBRARIES

NUCLEAR SCIENCE ABSTRACTS

[redacted] abstracts and published from reports declassified by the Atomic Energy Commission and from articles appearing in the published literature, both domestic and foreign, pertaining to atomic energy.

The abstracts in this journal are arranged according to broad subject categories with the abstracts of the AEC declassified documents appearing first in each category. An author, a subject, and a foreign geographic index are provided with each issue. Cumulated indices will be provided for each semi-annual volume.

Nuclear Science Abstracts and those AEC declassified documents so indicated in the abstracts are available for sale. All other documents cited are or will be available in published literature and are not for sale by the AEC. Current price lists of available documents may be obtained from:

Document Sales Agency
P.O. Box 62
Oak Ridge, Tennessee

Nuclear Science Abstracts for 1948 is now available on a subscription basis.

For the twelve issues of Vol. 1 (July 15 through Dec. 30, 1948)	$ 3.75
For the separate issues of Vol. 1	
Nos. 1 through 11, each	0.30
No. 12, with cumulated index	0.65

Issues for 1949 will be announced later.

Chemistry Library

NUCLEAR SCIENCE ABSTRACTS

QC
770
.U56
v.1
no.7

Volume I Number 7

Contents for October 15, 1948

Subject Category	Page
Adsorption and Scattering of Radiation	327
Atomic Power	327
Aviation	327
Biological Effects of Radiation	328
Biology, General	330
Ceramics	333
Chemistry, General	333
Cosmic Radiation	335
Crystallography	335
Fluorocarbons	336
Geophysics	336
Health Protection	336
Instruments	337
Isotope Separation	341
Laboratories	341
Mass Spectra	341
Metallurgy	342
Mineral Resources	343
Nuclear Physics	343
Nuclear Physics-Methods of Measuring	344
Nuclear Properties	346
Nuclear Theory	346
Nuclear Transformation	347
Neutrons	348
Particle Accelerators	349
Physics, General	350
Pumps	351
Radiation Sickness	352
Radioactivity	352
Radiochemistry	356
Radiography	357
Radiotherapy	357
Radon	358
Rare Earths	358
Scientific Research	359
Spectroscopy	359
Tracer Applications	360
Tracer Applications - Radioactive	360
Transuranic Elements	362
Uranium	364
Vacuum	367

Indices Follow Page 367

Location List of Atomic Energy Commission Declassified Documents

Document	Abstract No.	Page
AECD-2226	1160	347
AECD-2227	1181	352
AECD-2228	1086	328
AECD-2229	1146	343
AECD-2230	1137	341
AECD-2231	1177	351
AECD-2232	1182	352
AECD-2233	1183	353
AECD-2234	1100	333
AECD-2235	1101	334
AECD-2236	1134	341
AECD-2237	1097	333
AECD-2238	1218	362
AECD-2239	1173	350
AECD-2240	1117	337
AECD-2241	1219	363
AECD-2242	1098	333
AECD-2243	1118	338
AECD-2244	1223	364
AECD-2245	1162	348
AECD-2246	1184	353
AECD-2247	1224	365
AECD-2248	1091	330
AECD-2249	1212	360
AECD-2250	1161	347
AECD-2251	1140	342
AECD-2252	1119	338
AECD-2253	1099	333
AECD-2254	1092	330
AECD-2255	1120	338
AECD-2256	1220	363
AECD-2257	1205	359
AECD-2258	1108	335
AECD-2259	1163	348
AECD-2260	1185	353
AECD-2261	1186	354
AECD-2262	1135	341
AECD-2263	1221	363
AECD-2264	1187	354
AECD-2265	1225	365
AECD-2266	1222	363
AECD-2267	1226	365
AECD-2268	1174	351
AECD-2269	1164	348
AECD-2270	1147	344

Location List (Continued)

Document	Abstract No.	Page
AECD-2271	1121	338
AECD-2272	1102	334
AECD-2273	1148	344
AECD-2274	1165	348
AECD-2275	1166	349
AECD-2276	1093	331
AECD-2277	1195	357
AECD-2278	1114	336
AECD-2279	1141	343
AECD-2280	1094	331
AECD-2281	1167	349
AECD-2282	1227	365
AECD-2283	1095	332
AECD-2284	1149	344
AECD-2285	1208	359
AECD-2286	1150	345
AECD-2287	1169	349
AECD-2288	1228	366
AECD-2289	1229	366
AECD-2290	1188	355
AECD-2291	1142	343
AECD-2292	1168	349
AECD-2293	1213	361

ADSORPTION AND SCATTERING OF RADIATION

1080 Angular Correlation of Scattered Annihilation Radiation, by E. Bleuler and D. Ter Haar. Science 108, p. 10-12, July 2, 1948.

A calculation of the cross section for coincidence measurements of the scattering of two photons emitted in the annihilation of a positron and a negatron is made by the partial polarization analysis method. The formula for this cross section is: $\sigma_k = (\gamma_1 - 2 \sin^2 \theta_1 \cos^2 \alpha)(\gamma_2 - 2 \sin^2 \theta_2 \cos^2 \beta)$. The authors believe that their derivation shows more clearly what is done and which physical assumptions are implied than other derivations which have appeared in the published literature. Comparisons are made with the derivations of Snyder, Pasternack, and Hornbostel, (Physical Review 73, p. 440, 1948) and Pryce and Ward (Nature 160, p. 435, 1947).

1081 The Scattering of 2.4- to 3.5-Mev Protons by Protons, by J. Morris Blair, George Freier, Eugene E. Lampi, William Sleator, Jr., and John H. Williams. Physical Review 74, p. 553-561, September 1, 1948.

Collimated monoenergetic protons of 2.42, 3.04, 3.27, and 3.53 Mev were scattered by hydrogen gas and detected at angles from 8° to 45°. A complete diagram and description of the aluminum scattering chamber is given, as is a table of values of σ, the cross section per unit solid angle, for protons of different energies, detected at different angles. An interpretation of results is to be published later.

ATOMIC POWER

1082 Atomic Energy in the Service of Mankind, by J. A. Teegan. Beama Journal, p. 198-201, June 1948.

Atomic energy offers almost unlimited possibilities for aiding humanity. The release of energy from nuclear rearrangement and disintegration is not new; it is a fundamental process in nature, being the main source of all the energy in the universe. The discovery of releasing nuclear energy from terrestrial material can make a substantial addition to natural reserves for power production. No less important, however, are its applications in various fields of science and industry, and already the more recent discoveries in nuclear physics are leading to revolutionary developments in medicine, chemistry, biology, and agriculture. It is clear that the advent of atomic energy gives promise of spectacular advances in the future, and that future research in and development of its many applications must ultimately bring great material benefits to mankind.

1083 Cheap Fuel for Atomic Energy? By Leonard Engel. Science Digest 23, p. 87-89, February 1948.

The author suggests that thorium may soon be the key to cheap, new atomic energy processes.

AVIATION

1084 Atomic Engines for Aircraft, by A. Kalitinsky. Pegasus 16, p. 1-4, August 1948.

A future use of atomic energy as a source of aircraft power will undoubtedly produce airplanes combining extremely high speed and almost unlimited range. To achieve this, no new discoveries, but a great deal of engineering work will be required to develop the best possible type of atomic power plant. Pertinent types of power plants are all thermal, since fission energy is released predominantly in the form of heat. Practical possible types of an atomic power plant are the closed-cycle turbine, which may be a steam or mercury turbine; the turbojet; the ramjet; and the liquid-propellant rocket atomic power plants. The original cycles of these power-plant types would be mainly maintained, but a nuclear reactor will take the place of the boiler in the conventional steam turbine while assuming the function of the combustion chamber in the turbojet engine.

Many of the engineering problems, which lie in the path of the practical realization of atomic aircraft power plants, are connected with the use of high temperatures, which affect the vital specific fuel consumption; a problem still aggravated by the heat transfer aspects. Other problems embrace

AVIATION

the protection of the uranium in the reactor against corrosion by the working fluid, and the weight conditions, since large amounts of mass are needed to stop radiations emitted during the fission process. All these problems in their numerous relations to components, accessories, design, and performance require the increasingly active cooperation not only of the engineers and the industry, but also of the physicists, mathematicians, and chemists. (TID)

1085 NEPA New Enginnering Problem. Aviation Week, p. 29, July 1948.

Development of atomic power - for aircraft as well as other installations - is now predominantly an engineering problem. More is probably known about uranium fission than about basic mechanisms of combustion or supersonic aerodynamics. The main advantage of atomic propulsion for aircraft is the possibility of combining high performance and long range, since the fuel supply would remain nearly constant. The problem of protection against radiation damage is resolvable into two considerations - "shielding" and "canning". Crash danger would lie not in the reactor continuing to function but in the "ash" products of fission already formed at the time of the crash. Various basic types of power plants could be adapted to use atomic energy for aircraft propulsion, such as turbine, turbojet, ramjet, and rocket types. (TID)

BIOLOGICAL EFFECTS OF RADIATION

1086 Influence of Total Surface Beta Irradiation on the Gross Metabolic Pattern of Rats, by Elizabeth Anderson. AECD-2228 (MonH-122), July 30, 1946, decl. August 23, 1948. 20 p. For publication in NNES.

Food intake and weight of feces, water intake and volume of urine, body weight, specific gravity of urine, and the presence or absence of urine albumen were followed in rats which had received total surface irradiation with 5,000, 7,500, and 10,000 rep of beta rays. The magnitude of effect of beta rays was found to be proportional to dose. Results on food and water consumption showed reduction during the first fifteen days after exposure, followed by over-compensation from the fifteenth day on. The amount of food rats were able to retain for use in the body after the fifteenth day decreased in proportion to the degree of increase above normal. Water intake was closely connected with wet desquamation, remaining much above normal as long as large amounts of body fluid were being lost through the skin and decreasing toward control level as healing of the skin progressed. The volume of urine was abnormally low and therefore of a higher than normal specific gravity until after beta ray damage to the skin had been repaired. Presence of urine albumen of questionable origin had no effect on specific gravity. Normal growth was prevented for thirty-five days after exposure in the 5,000 and 7,500 rep animals and for sixty days in the 10,000 rep animals. Growth was affected by the degree of damage to the skin, the efficiency with which food was utilized in the body, and the age of the animal. Death could not be attributed to starvation but was probably hastened by the loss of much weight and by the escape of body fluid through raw, ulcerated areas of the skin.

1087 The Effect of X-Ray on Mortality, Weight, Length, and Counts of Erythrocytes and Hematopoietic Cells in Fingerling Chinook Salmon, Oncorhynchus Tschawytscha Walbaum, by Helshaw Bonham, Lauren R. Donaldson, Richard F. Foster, Arthur D. Welander, and Allyn H. Seymour. Growth 12, p. 107-121, June 1948. (See also MDDC-1416).

Eight groups of fingerling chinook salmon, Oncorhynchus tschawytscha Walbaum, were subjected to different x-ray doses graduated from 100 r to 5000 r, and one group was used as a control. The lowest exposure levels at which irradiated groups were significantly adversely affected twelve weeks after exposure were, in mortality 250 r, in weight 500 r, and in length 1000 r. Group means when tested against the mean of all 9 groups combined showed significant decline in number of cells in the circulating blood at exposures of 750 r and 1250 r two and three weeks after irradiation. Concentration of hematopoietic cells in the kidney showed similar decline in the 750 r group one and two weeks after irradiation.

BIOLOGICAL EFFECTS OF RADIATION

1088 Mitotic Effects of Ultraviolet Radiation of the 2250 A Region, with Special Reference to the Spindle and Cleavage, by J. Gordon Carlson and Alexander Hollaender. Journal of Cellular and Comparative Physiology 31, p. 149-173, April 1948.

Exposure of grasshopper neuroblasts to 2250 A ultraviolet radiation in doses ranging from 541 to 138,600 ergs/cm^2 produced mitotic delay. As measured by the delay in the time required for a cell to progress to anaphase, cells treated in interphase were most sensitive to treatment, those in prophase less sensitive, and those in prometaphase and metaphase least sensitive.

Irrespective of the delay produced by pre-anaphase treatment, the rate of progress through anaphase is normal. Cells in middle prophase treated with doses of 34,650 ergs/cm^2 and those in late prophase with 8,662 ergs/cm^2 undergo changes in their chromosomes simulating mitotic reversal, from which recovery usually takes place. Cells in late metaphase and anaphase exposed to 34,650 ergs/cm^2 suffer spindle reduction, which frequently leads to equal instead of the normal unequal division. Cells in very late prophase, prometaphase, and metaphase, when treated with 69,300 or 138,600 ergs/cm^2 usually sufer so complete a destruction of the spindle that the chromosome halves do not separate but are all incorporated in a single tetraploid nucleus. Large pseudopodia-like outpushings of the cell precede the telophasic transformation of the chromosomes. One of these pseudopodia is eventually cut off from the nucleated mass of the cell by a cleavage furrow.

Mitotically delayed cells in which the spindle is reduced in size contain single large hyaline globules, which appear to form from the clear nuclear substance that would normally have contributed to spindle formation. Spindle deficiency may lead to the formation of other focal points on the spindle substance about which the chromosomes become temporarily oriented, but division processes do not proceed until these chromosomes have moved into the equatorial plate.

On the basis of the contrast between the effects produced by a wave length absorbed principally by nucleic avid (e.g. 2537 A) and a region such as 2250 A, which is probably absorbed mainly by the protein cell components, it is suggested that the protein absorption is primarily responsible for spindle destruction and abnormal division. Doses of 8,662 ergs/cm^2 and higher transform each nucleolus into a group of highly refractile spheres, which gradually fuse to form a single spherical body that persists into prometaphase.

1089 Resuscitation of Heat-Inactivated Seeds with X-radiation, by Richard S. Caldecott and Luther Smith. Journal of Heredity 39, p. 195-198, July 1948.

In this study a series of experiments was made to determine the effect of pre- or post-irradiation in combination with a barely lethal heat treatment on dormant einkorn and barley seeds. The amount of irradiation varied from 12,000 r to 36,000 r units for the barley and from 6,000 r to 22,000 r for the einkorn at 27 kv potential and 15 milliamp. The time of irradiation was 30 minutes. It was found that the einkorn and barley responded in the same way to similar combined heat and x-ray treatments, but at different levels of dosage. Seeds which were x-rayed immediately after a heat treatment were 90 per cent resuscitated by a wide range of dosages. The seeds which were x-rayed before they were given a lethal heat treatment were protected from inactivation by some relatively low and high x-ray dosages (24,000 r and 36,000 r), but not by an intermediate dosage (30,000 r). The mean survival of barley seeds given a treatment followed by x-raying was greater than the mean survival of seeds irradiated only. In this case the heat treatment seems to protect the seeds from the irradiation. The data collected in these experiments do not appear to substantiate the hypothesis that the killing effect of heat is caused simply by coagulation of protoplasmic proteins.

10 references.

1090 Some Observations on the Nature of Radiations Emitted by X-Ray Tubes (Quelques Observations sur la Nature des Radiations Emises par les Tubes a Rayons X), by Jean Manoukhine. Comptes Rendus 227, p. 56-58, July 5, 1948. (In French)

The influence of various types of modern X-ray tubes on the splenic activity was investigated by irradiating the spleens of four patients with the following types: the air-type tube, the Securix type, and the Standard type tube. Only in the case of treatment with the air-type tube was leucocytolysis

observed, while irradiation by the Securix type and by the Standard type depressed the splenic activity. The security bath (transformer and tube in the same oil bath) never showed any positive action but had a depressing influence at very small doses; the oil did not inhibit the radiations. The Coolidge Standard tube also was found to have depressing action, while with the classical type of Coolidge tube the production of leucocytolysine was found to be neither as strong nor as rapid as with the air-type tube.

BIOLOGY, GENERAL

1091 Biometric Investigation of Blood Constituents and Characteristics in a Population of Project Workers, by G. A. Sacher, L. O. Jacobson, and E. K. Marks. /.ECD-2248 (CH-3871), May 10, 1948, decl. August 26, 1948. 31 p. For inclusion in NNES.

An empirical analysis was made of the quantitative characteristics of the sedimentation process in a large group of University of Chicago Metallurgical Laboratory employees. The data consisted of 20, 40, 60, and 80-minute readings on Westergren tubes. Logarithm of sedimentation distance in millimeters and logarithm of time were found to be the most appropriate variables to employ in discussing the sedimentation process. The reasons for choosing these variables are: (a) Logarithm of sedimentation distance at fixed times of measurement is normally distributed in the population. (b) Standard deviations of the distributions for different times of measurement are approximately equal. (c) Logarithm of sedimentation plotted against logarithm of time for individual subjects shows little departure from linearity even for rapidly sedimenting samples followed for 80 minutes.

The complete sedimentation curve plotted in log-log coordinates can be described in all its salient features as a four-parameter hyperbola. This represents a considerable simplification, both conceptually and for computational purposes. The two constants describing the slope and intercept of the straight-line relation are the minimum number for an adequate description of sedimentation even in its early stages. Both vary considerably between individuals, and it is shown that they vary independently to an important extent. Previous inability to establish reproducible correlations between sedimentation and other variables may have resulted from the use of insufficient data about the sedimentation process. The successful rectification of the sedimentation curve permits the use of very simple procedures for estimating the constants of the sedimentation process. The usefulness of sedimentation data would be considerably increased if time were employed as the variable rather than sedimentation distance, for the constants of slowly sedimenting samples could then be estimated with accuracy.

1092 The Metabolism of Carrier-Free Be^7 In the Rat, by Josephine F. Crowley, Joseph G. Hamilton, and Kenneth G. Scott. AECD-2254 (UCRL-148), July 15, 1948, decl. September 3, 1948. 10 p. For publication in a technical journal.

Recent studies have shown that the soluble Be compounds are toxic, and the toxicity is a function of both Be and the anionic part of the molecule. Acute beryllium poisoning manifests itself in at least three organ systems of the body, midzonal necrosis of the liver, necrosis of the distal third of the proximal convoluted tubule of the kidney, and poisoning of the hemopoetic system leading to anemia and leucocytosis. Owing to the necessity of using at least micrograms of material when studies are made with stable isotopes of beryllium, it is difficult to measure the normal metabolism of beryllium because of its toxicity. When a radioactive isotope of this element is used the actual number of beryllium atoms which can be traced is reduced by a factor of at least 10^6. For this reason it is possible to ascertain the manner in which the normal animal handles extremely minute amounts of beryllium which are far below the possible levels of chemical toxicity.

The metabolism of beryllium in the rat has been investigated with tracer amounts of carrier-free Be^7. About one half microcurie of Be^7 in anistonic solution was administered to each rat via intramuscular injection. Within 24 hours 40% of the Be^7 had been absorbed from the injection site and 53% of the absorbed Be^7 had been eliminated from the body, mainly in the urine. By the 64th day after injection, a total of 80% had been absorbed from the injection site and 70% had been eliminated from the body. Of the absorbed Be^7 which remained in the body, the major portion was taken up by

bone. Within 24 hours after injection, the bone had accumulated 29.4% of the absorbed Be^7 and maintained this level to the 64th day, when the bone contained 26.9% of the absorbed material. Many of the soft tissues of the body demonstrated a small initial uptake followed by a ten fold decrease in Be^7 content by the 64th day. The radioberyllium content of the spleen and muscle remained relatively constant throughout the interval of the experiments. Less than 0.1% of the Be^7 administered orally was absorbed from the intestinal tract.

1093 The Ratio of Urinary Amino Acid Nitrogen to Creatinine as a Sensitive Test for Uranium Poisoning in the Rabbit, by Harry Berke. AECD-2276, February 2, 1948, decl. May 24, 1948. 142 p. For use as a thesis. (See also AECD-2150).

It has been shown that the ratio amino acid nitrogen/creatinine in spot samples of urine is a sensitive test of uranium poisoning in the rabbit. This ratio was far more constant in untreated animals than the amino acid nitrogen concentration because it eliminated fluctuations due to varying rates of urinary flow. It was even more constant than the rate of excretion of amino acids and required only a spot sample of urine whereas the determination of the rate of excretion required a 24-hour sample. Because uranium poisoning results in a rise of amino acid excretion, but little change in that of creatinine, the ratio can be used as a measure of the effect of uranium on amino acid excretion. In rabbits the minimal dose of uranium which elicited a significant response in the ratio was 0.02 mg U/kg. This dose was less than that needed for responses in urinary protein, blood, non-protein nitrogen, or renal function as measured by the PSP test. Plasma levels of amino acid nitrogen did not change after uranium poisoning, indicating the renal origin of uranium induced amino aciduria.

The ratio was applied as a test to rabbits repeatedly injected with graded levels of uranium (0.04, 0.10, and 0.20 mg/kg). In general, the ratio rose to a maximum in value a few days after each poisoning, then slowly declined, but in all cases remained well above control values. Three distinct trends, however, in these maxima were observed. In one, the highest value of the ratio for any injection period occurred after the first or second injection and the maxima progressively declined with each subsequent poisoning. In another, the maxima in ratio reached about the same value after each poisoning. In the third, only observed at the highest dosage level (0.20 mh U/kg), the maxima in ratio showed progressive increases in height after each uranium poisoning.

The advantages inherent in using the ratio as a test of U poisoning are as follows: (1) it is analytically simple and fast, (2) it is very sensitive, (3) it is applicable to spot samples of urine, (4) it differentiates variations in amino acid nitrogen caused by changes in the rate of urinary flow from increases due to the renal damage following uranium exposure, (5) it will detect the renal damage caused by repeated uranium injections at a level of 0.04 mg/kg and higher for at least a few months after exposure to uranium is terminated. The disadvantages of the test are concerned mainly with its lack of specificity. Nevertheless, the use of the ratio as a diagnostic test for uranium poisoning is valid when known interferences are absent and exposure to uranium has been experienced. 59 references.

1094 An Outline of a Beryllium Program, by Harold C. Hodge, Joe Howland, Sidney Laskin, Elliott A. Maynard, William F. Neuman, Aser Rothstein, James K. Scott, Herbert E. Stokinger. AECD-2280 (UR-27), May 6, 1948, decl. September 14, 1948. 24 p. Informal Disposition. Document for sale by AEC.

This outline of investigations of the toxic effects of beryllium was prepared to clarify the relation of University of Rochester research projects to what might be called the broad aspects of the problem. It is believed that, in the present confused state of knowledge of the toxicity of beryllium, other workers in the field might find such a summary useful. In form, this outline is so general that it might serve as the basis of a toxicological research program on any metal. In detail, however, this outline contains only those problems which seem to us at present to bear acutely on the nature of beryllium poisoning.

The scope of the program outlined is inclusive; experiments are indicated on animals; observations on clinical material as well as environmental studies are included; and finally, a number of physical

and chemical properties are listed which should be studied in an effort to understand how beryllium acts in the body. All the critical problems apparent are listed. No attempt was made to indicate which of these have already been worked on, which are currently under investigation, or which will be studied at some indefinite time in the future.

There are five main headings under which problems are grouped: Under Chemistry and Physics, the emphasis is laid on methods and instruments, although a number of specific properties are mentioned which have a bearing on beryllium poisoning. Under Toxic Effects, a large number of observations are indicated, both on humans and animals, covering a variety of fields. Under Toxic Limits, the relationships are considered between the amounts of beryllium, times of administration, and the toxic sequelae. Under Fate, are listed the problems of the distribution and excretion of beryllium and, in general, of what the body does with beryllium. Under Mechanism and under Detection, Prophylaxis, and Therapy little more than the broadest generalities are stated.

1095 Preliminary Studies of the Toxicity of Thorium, by H. Ackerman, R. P. Allen, G. Bonner, W. L. Downs, H. C. Hodge, E. A. Maynard, W. F. Neuman, J. K. Scott, A. Sparks, and H. E. Stokinger. AECD-2283 (UR-13), February 26, 1948, decl. September 15, 1948. 44 p. Informal disposition. Document for sale by AEC.

Thorium Nitrate: Acute Toxicity in Rats. Adult albino rats were given various doses intraperitoneally of an aqueous solution of thorium nitrate. The LD50 in 24 hours is of the order of 1770 mg/kg. This represents a low order of toxicity.

Toxicity Following Intratracheal Administration. The LD50 of thorium nitrate (24-hour kill) was found to be of the order of 85 mg/kg. A comparable value for throium dioxide could not be determined; 1000 mg/kg were tolerated apparently without effect for at least four months. In surviving animals studies are underway in which mortality is recorded, periodic lung x-rays are made, and lung pathology is observed in sacrificed animals. No consistent lesions which could be attributed to the thorium compounds were found in any organs other than the lung. Thorium nitrate provoked a peculiar focal coalition of monocytes in the alveolar sacs. Thorium dioxide provoked minimal or no response.

Short-Term Feeding Studies of Thorium Nitrate. In a pilot study a few young and two adult rats were fed diets containing very high percentages of thorium nitrate, viz., 10 and 20% for the weanlings, 10% for the adult rats. The weanlings fed 20% died promptly. The weanlings fed 10% grew very little but survived for 11 months. A small scale paired feeding study demonstrated clearly that the weight depression was only partly due to the decreased food consumption. Based on earlier experiments, larger groups of male and female rats were fed diets containing 0, .05, 1, and 10% thorium nitrate. Severe weight reductions and deaths were recorded on the highest dietary percentages. Weanling rats, in groups of 20 males and females each, were placed on diets containing 0, .05, 1.0, 3.0, 5.0, 8.0, and 10% thorium. In a 6-week period, a regular pattern of growth depression was established, with increasing effect observed in the rats fed higher amounts of thorium nitrate.

Distribution and Excretion Studies. A natural radioisotope of thorium, UX_1, (Th-234) is available, having a half life of about 25 days, and emitting a hard beta radiation. Small amounts of thorium marked with UX_1 were administered intravenously, intramuscularly, by stomach tube, and intratracheally to a number of animals including rats, rabbits, and guinea pigs. Administered intravenously, thorium is slowly lost from the blood and appears in major proportion in the liver. At 6 hours the balance is present in the spleen, intestine, and other organs, including bone and bone marrow. Fourteen days after an intravenous dose, the liver still contains a large fraction of the total amount given. About one-third of the dose is excreted in the feces; a much smaller percentage in the urine. Roughly, one-tenth of the dose is in the carcass, probably mostly in the bone and the bone marrow. The other organs still account at this late date for approximately 15% of the dose.

Administered by other routes, the principal idea that emerges is that wherever thorium is placed, it tends to stay; for example, in rats given a soluble thorium compound intramuscularly, 91 to 94% of the dose has been recovered from the site four days later. Rats and guinea pigs given a solution of thorium nitrate by stomach tube excrete 67 to 100% in the feces; absorption is very limited, i.e.,

BIOLOGY, GENERAL

considerably less than 1%. A soluble thorium compound administered intratracheally either stays in the lung or is brought up by the ciliated epithelium and deposited in the gastrointestinal tract. Recoveries of 85 to 90% of an intratracheal dose have been found four days later in lung and gastrointestinal tract combined.

1096 Pathologic Anatomy of Acute Experimental Beryllium Poisoning, by James K. Scott. Archives of Pathology 45, p. 354-359, March 1948. (See also MDDC-1237).

The lesions occurring in various organs of rats, rabbits and guinea pigs after administration of beryllium sulfate intravenously are described. These were focal necrosis of the liver, tubular epithelial necrosis of the kidney and degenerative changes of the hemopoietic system. The pulmonary lesions occurring after inhalation of beryllium sulfate dust are also described.

CERAMICS

1097 Pure Refractory Materials, by F. H. Norton. AECD-2237, n.d., decl. August 25, 1948. 5 p. For publication in revised edition of Refractories, by F. H. Norton.

A discussion of sulfides as refactory materials is presented. The preparations and properties of CeS and ThS are stressed.

1098 The Preparation and Properties of Refractory Sulfides, by Leo Brewer, LeRoy Bromley, Paul Gilles, and Norman Lofgren. AECD-2242 (MB-LB-18-5), n.d., decl. August 25, 1948. 47 p. Informal disposition and for publication in NNES.

The methods of preparation of the sulfides of cerium, thorium, uranium, and barium are discussed. Where necessary, the apparatus is described. Procedures for the handling and grinding of the sulfides and hydrides which are used for their preparation are given. A dry box which has been found convenient for these operations is described in detail.

The physical, mechanical, chemical, and thermodynamic properties are given for various sulfide refractories which have been developed at the Berkeley, California, chemical laboratories. The substances discussed are BaS, CeS, Ce_3S_4, Ce_2S_3, ThS, Th_2S_3, Th_4S_7, ThS_2, US, U_2S_3, US_2, and solid solutions of the "two plus" sulfides. 33 references.

1099 The Preparation and Tests of Refractory Sulfide Crucibles, by Leo Brewer, LeRoy Bromley, Paul Gilles, and Norman Lofgren. AECD-2253 (MB-LB-18-10), n.d., decl. September 7, 1948. 32 p. For inclusion in NNES, and for informal disposition.

Crucibles have been prepared from all of the sulfides of barium, cerium, and thorium, and also from some of the mixed sulfides of cerium with thorium, and uranium with thorium. The type of molds used as well as the methods of pressing of the sulfide powders are described in detail. Sintering procedures and techniques are listed for each of the various refractories. Over 800 refractory sulfide crucibles have been produced by the procedures described. These crucibles have ranged from extremely small containers with 0.0026 cc. capacity to crucibles with 50 cc. capacity. Tests of these crucibles indicate that they are satisfactory refractories for a large number of metals and halides. Tests of the individual sulfide refractories as containers for various melts are summarized. The individual differences as well as similarities of the sulfide refractories are pointed out.

CHEMISTRY, GENERAL

1100 The Isolation and Identification of Alkylated Phosphoric Acids, by Dave Lipkin. AECD-2234 (LADC-548), n.d., decl. August 23, 1948. 3 p. For publication in Journal of the American Chemical Society.

The reaction between benzyl alcohol and ethyl metaphosphate gives rise to a complicated mixture of alkylated phosphoric acids. In the course of an investigation of this reaction, two difficulties were encountered in attempting to separate the acids in the reaction mixture by fractional precipitation or

crystallization of their barium salts. First, it was difficult to follow the fractionation since the barium salts do not, in general, have characteristic melting or decomposition points. Second, the barium salts of the alkylated phosphoric acids present in the reaction mixture could not readily be separated into pure components since they show a marked tendency to co-precipitate.

The first of these difficulties was solved, in part, by equivalent weight determinations on the various barium salt fractions. The equivalent weight of salts can be readily and rapidly determined with an accuracy of about 0.5 - 1% by the use of ion exchange resins. Two cation exchange resins have been used for this purpose, Amberlite IR-100H or Dowex 50. It has been found that the salts of S-benzylthiourea with alkylated phosphoric acids serve well for the fractionation of mixtures such as are obtained by the reaction mentioned above. These derivatives can be crystallized readily from a variety of solvents and have sharp melting or decomposition points. By the use of the S-benzyl-thiuoronium salts it was possible to overcome both of the difficulties mentioned above in connection with the use of the barium salts.

1101 Pentavalent Manganese, by H. H. Miller and L. B. Rogers. AECD-2235 (ORNL-81), June 14, 1948, decl. August 16, 1948. 11 p. For publication in Science.

It had been previously determined that, in fused alkaline melts, the lower oxides of manganese react with oxygen until an oxygen-to-manganese ratio of about 2.5 is established (Mellor, Comprehensive Treatise on Inorganic and Theoretical Chemistry, 12th ed., p. 284). For aqueous media, reliable evidence pointing to the existence of pentavalent manganese has apparently not been reported. The present paper shows that such a valence state can be detected polarographically in strongly alkaline solutions. A solution containing 1.00×10^{-3} M potassium permanganate and 0.1M sodium hydroxide was deaerated with nitrogen and then polarographed using a stationary platinum electrode and an outside saturated calomel electrode. The resulting curve is shown. A study of the curve reveals that the reactions $Mn^{+6} \longrightarrow Mn^{+5}$ and $Mn^{+5} \longrightarrow Mn^{+4}$ must be taking place. Preliminary studies have been made using other concentrations of sodium hydroxide.

1102 The Aqueous Chemistry of Zirconium, by R. E. Connick and W. H. McVey. AECD-2272 (UCRL-101), March 1, 1948, decl. September 9, 1948. 57 p. Informal disposition. Document for sale by AEC.

A system involving a two phase equilibrium was used to study the chemistry of zirconium in the +4 oxidation state in dilute acid solution. The equilibrium studied was one between the various zirconium species in an aqueous phase and the thenoyltrifluoracetone chelate of zirconium in a benzene phase. From this study it was shown that the zirconium species in 2.00 M perchloric acid is principally $ZrOH^{+3}$ which hydrolyzes further at lower acidities to form $Zr(OH)_2^{+2}$.

Equilibrium quotients were obtained for the equilibria existing between $ZrOH^{+3}$ and zirconium species complexed by one and two sulfate groups in 2.00 M $HClO_4$. It was established that in a 2.0 M solution, 0.015 M in bisulfate ion, there is an average of one sulfate group per zirconium and two sulfate groups per zirconium at the bisulfate concentration of 0.2 M.

The fluoride complexes of zirconium in 2.0 M $HClO_4$ were found to be by far the most stable of any of the complexes studied. Values for the equilibrium quotients for reactions involving complexing of zirconium by one, two and three fluoride ions were obtained. At a hydrofluoric acid concentration of 2×10^{-5} M, there is an average of one fluoride group per zirconium; at 3×10^{-4} M, an average of 2 fluoride ions per zirconium and at 10^{-2} M hydrofluoric acid an average of three fluorides attached to each zirconium.

The oxalate complex of zirconium is very stable even in 2 M $HClO_4$, whereas the next three members of the aliphatic, dibasic acids show little tendency towards complexing. Chloride and nitrate ions form only weak zirconium complexes of nearly equal stability.

1103 A Radioactive Local Anaesthetic, by Frank Howarth. Nature 161, p. 857, May 29, 1948.

A method of preparation of radioactive dibromoprocaine from HBr containing radioactive bromine and procaine is described. The yield is almost quantitative.

COSMIC RADIATION

1104 Measurements of the East-West Asymmetry of Cosmic Rays at Hobart, Tasmania, by A. G. Fenton and D. W. P. Burbury. Physical Review 74, p. 589-591, September 1, 1948.

Measurements of the high latitude asymmetry of cosmic rays have been made at Hobart in geomagnetic latitude 51.7° south. A Geiger counter telescope has been used at a zenith angle of 45° with and without 12.5 cm of lead absorber. The asymmetry is increased by a factor just over two when the lead is used. The increase indicates that the hard component of the radiation is responsible for the high latitude asymmetry, and the magnitude of the increase suggests a preferential absorption of negative particles by the lead.

1105 On a New Type of Penetrating Particle in Extensive Cosmic Ray Showers, by P. Auger, J. Daudin, A. Freon, and R. Maze. Comptes Rendus 226, p. 169-170, January 12, 1948. (In French).

A particle of a few times the electron mass which comprise about one-fourth of the ionizing particles in extensive showers has been reported. The authors arrive at this conclusion from a study of the absorption of extensive air showers in lead, the degree of multiplication of these shower particles, and the Rossi curve for the particles.

1106 Plasma Oscillations as a Cause of Acceleration of Cosmic-Ray Particles, by D. Bohm and E. P. Gross. Physical Review 74, p. 624, September 1, 1948.

It is suggested that plasma oscillations of ion clouds in intra-galactic space can provide the effects producing cumulative energy transfers, which may explain the high energies of cosmic rays. The starlight source alone, it is suggested, can explain the energy supply.

1107 Shower Production by Penetrating Particles at 14,000 Feet, by H. Bridge and W. Hazen. Physical Review 74, p. 579-588, September 1, 1948.

The nature of the showers that have been observed at high altitude under lead shields thick enough to exclude electron or photon initiated showers was studied at 14,000 feet by simultaneous observations with Geiger-Müller counters, a cloud chamber, and an ionization chamber in a combined array.

Photomicrographs are given of "mixed showers" (showers containing heavy particles as well as energetic electronic radiation) and penetrating particle showers. At least two-thirds of the observed showers generated by penetrating particles that struck a five-inch lead absorber consisted of a mixture of energetic electrons and particles heavier than electrons. The initiating particles are seen not to be ordinary mesons. The showers seem to result from nuclear interactions in which the nucleus in disrupted rather than from a simple radiation process, as is seen from the presence of heavier particles. The article contains a discussion of the details of the events and their relation to some other cosmic-ray phenomena.

CRYSTALLOGRAPHY

1108 An Apparatus for the Production of Large Metallic Crystals by Solidification at High Temperatures, by Louis Gold. AECD-2258, n.d., decl. September 2, 1948. 23 p. For publication in Review of Scientific Instruments.

The apparatus described is a relatively simple arrangement for growing large metal crystals; the design features allow for reasonable flexibility. The basic components of the apparatus consist of a vacuum system, a furnace chamber, a furnace unit, the power supply and temperature control, and the crystal lowering and raising mechanism. These components are described in detail. The operational procedure used in a typical run is given. The sequences in this procedure are loading, starting the apparatus, outgassing and preheating the furnace chamber, raising the specimen into the furnace and melting it, lowering the specimen from the furnace chamber, and finishing the run. Each step in the operational procedure is carefully described. A photograph of the assembled apparatus and a diagram of the furnace chamber are given. 26 references.

CRYSTALLOGRAPHY

1109 Table of Interplanar Spacings in Angstrom or K.X. Units in Terms of 2θ for Different Target Materials, by Suzanne Van Dijke Beatty. Physical Review 74, p. 625-626, September 1, 1948.

Tables giving d values for Mo, Cu, Co, Fe, and Cr targets between the 2θ values 5.0° and 85.0° may be obtained from the Westinghouse Research Laboratories in East Pittsburgh, Pa. The tables list every tenth of a degree between 5.0° and 70.0°, every two-tenths between 70.0° and 80.0°, and every five-tenths between 80.0° and 85.0°. Since angular units are given, no reductions are necessary to compensate for different counter-arm lengths.

FLUOROCARBONS

1110 The Identification of C_3F_6, by F. A. M. Buck and R. L. Livingston. Journal of the American Chemical Society, 70, p. 2817-2818, August 1948.

Interpretation of electron diffraction photographs of C_3F_6 lead the authors to conclude that the compound is hexafluoropropane not hexafluorocycloprone.

1111 On the Molecular Structure of ("Cyclic") C_3F_6, by Walter F. Edgell. Journal of the American Chemical Society 70, p. 2816-2817, August 1948.

Two independent studies show clearly that C_3F_6 does not have the cyclopropane structure. Buck and Livingston (Journal of the American Chemical Society 70, p. 2817, 1948) reached this conclusion from electron diffraction studies. The present authors reach the same conclusion from a study of the Raman effect.

1112 The Structure of C_3F_6, by Edmond G. Young and William S. Murray. Journal of the American Chemical Society 70, p. 2814-2815, August 1948.

C_3F_6 was prepared by the pyrolysis of tetrafluoroethylene polymer, and by dechlorination of $CF_3CFClCF_2Cl$ with Zn and alcohol. Molecular weight, boiling point, and freezing point determinations showed the products to be identical. The two C_3F_6 products formed dichlorides which were identical, and different from the dichlorides obtained by chlorination of $H(CF_2)_3Cl$ and by fluorination of $CFCl_2CF_2CFCl_2$. Therefore C_3F_6 obtained by pyrolysis of tetrafluoroethylene polymer, is $CF_3CF{=}CF_2$ and not $CF_2CF_2CF_2$.

GEOPHYSICS

1113 Thermal Consequences of the Capture of Neutrinos by the Earth, by A. E. Benfield. Physical Review 74, p. 621, September 1, 1948.

The conclusions reached by Crane (Reviews of Modern Physics 20, p.294, 1948) on the neutrino capture cross section are objected to by pointing out that the surface temperature gradient of the earth would now be only 16 per cent of its final value when $t = \infty$, using Carslaw and Jaeger's solution (Conduction of Heat in Solids, Clarendon Press, Oxford, 1947, p. 207). It is concluded that the cross section from geophysical evidence should be used with a significantly smaller margin of safety.

HEALTH PROTECTION

1114 Photographic Neutron Dosimetry to Date, by Gerhard Dessauer and Edwin Lennox. AECD-2278 (M-1525A). July 14, 1944, decl. September 14, 1948. 4 p. Informal Disposition. Document for sale by AEC.

The development of a method applicable to the monitoring of neutron doses is discussed. The daily fast-neutron dose considered safe is approximately .01 n units where "n units" refers to the number of r units read in a standard Victoreen 100 r chamber when it is inserted into a neutron beam. Inasmuch as neutrons do not cause ionization themselves, a secondary neutron effect is necessary to produce darkening of the photographic film. Whatever secondary effects are produced by fast neutrons

HEALTH PROTECTION

in the film itself are far too weak to produce a measurable effect for a dose of the above size. The problem was therefore one of producing secondary ionizing radiation in the immediate proximity of the emulsion. This "intensification" of the neutron effects has to be strong enough not only to produce a measurable density, but also to yield a distinct difference in density on the film between regions exposed to the neutron secondaries and the regions exposed to beta or gamma ray dosages of the tolerance level. The latter condition must be fulfilled because it turned out to be impossible to shield a film completely from either type of radiation alone, in the presence of both. Cadmium was found to be the best neutron "intensifier". Best results were obtained when workers wore a film covered with a Pb strip for gamma radiation detection and a Cd strip for neutron detection. The calibration and standardization procedure is described.

1115 The Hazards of X-Ray. Journal of the American Medical Association 138, p. 214-215, September 18, 1948.

New researches, including some by health physicists and biologists connected with the development of the atom bomb, have revealed much more about the hazards of x-rays and radium. Even small quantities of roentgen or radium rays can be damaging. It is pointed out that big doses are needed in treating cancer and that damage to normal tissue is worth the cure of the cancer; but it is suggested that benign conditions should not be routinely treated with x-rays. Other forms of therapy should first be tried. Ill-advised treatment of "strawberry marks" in children has been followed by scars, telangiectases, arrest of epiphysial growth and deformed limbs; the danger limit is easily exceeded in treating recurring cases of allergic dermatitis; instances of ulceration have occurred following irradiation of warts even by trained radiologists; and alopecia has followed epilation to cure ringworm of the scalp in children. From these examples it is evident that roentgen treatment for benign conditions should be used only with a vivid appreciation of its ability to harm and after its presumed benefits have been weighed against the known and possible injuries inseparable from its use in effective dosage.

1116 Isotopes and Radiation Hazards, by Frank Howarth. Lancet 255, p. 51-53, July 10, 1948.

The characteristics of the various radiations emitted by radioactive isotopes is described in this extensively cross-referenced review article. The effects of such radiations on the skin, blood, and sperm is discussed; the toxicological effects of ingested radioisotopes is briefly covered.

The author concludes that in human experimentation, there is no excuse for using an isotope technique when some ordinary chemical procedure can suffice. If the problem will not yield to a chemical approach, it is desirable before using a radioactive isotope to consider the possibilities offered by a stable isotope which can be readily detected and, with the exception of deuterium, can be administered ad lib without biological effect. Radiophosphorus should not be used in the treatment of patients in the reproductive period of life, or who have an expectation of life of five years or more. Isotope work is totally unsuited to a general laboratory such as the clinical laboratory of a hospital. Unless special precautions are taken, the benches, sinks, and furniture can become heavily contaminated with radioactive materials; and, if elements of long half-life, such as Co^{60}, Sr^{89}, or Zn^{65}, are used, the accumulated radiation may soon reach a dangerous level.

INSTRUMENTS

1117 Electrolysis with a New Type Mercury Cathode Cell, by Joseph Rynasiewicz. AECD-2240, n.d., decl. August 17, 1948. 3 p. For publication in Analytical Edition of Industrial and Engineering Chemistry. This includes declassification of the mercury cathode cell and special stopcock.

The cell was designed for electrolytic removal of iron and other elements. It facilitates the amalgam-electrolyte separation without resorting to a mercury-leveling bulb attachment. Description and operation are detailed. A diagram of the mercury cathode cell and special stopcock is given.

1118 Design and Construction of the "Pee Wee" Portable Proportional Alpha Survey Meter, by J. H. Larkins. AECD-2243 (LADC-547), June 10, 1948, decl. August 23, 1948. 30 p. Informal disposition. This includes declassification of the "Pee Wee" portable and proportional survey meter.

The "Pee Wee" portable proportional alpha survey-meter uses an electronic circuit which has proved to be quite stable and reliable. The "Pee Wee" is housed in a single aluminum box 5 3/8" x 8" x 11 1/2" and weighs approximately 15 pounds. The box has a door at each end to provide easy access to the elements for servicing. The meter is mounted in the top at one end and the controls grouped around it so that those most frequently used, the range switch and reset switch, are near the handle and may be operated with one hand while carrying the instrument. Two unique features of the "Pee Wee" are the removable amplifier unit and input circuit. Construction of box; wiring; input circuit; amplifier panel; components; and counting characteristics are described in detail. 14 photographs.

1119 Construction and Operation of Pulsed Counter Tubes, by J. S. Allen and B. Rossi. AECD-2252 (LADC-137), August 31, 1944, decl. September 2, 1948. 13 p. Informal Disposition.

A new type of small counter tube has been developed. This counter can be made sensitive for short predetermined intervals of time and gives output signals of the order of 1000 volts. Constructional details and operational characteristics are discussed in the present report. The principle adopted in the design of the detector is based upon the fact that if the voltage is raised across a spark gap somewhat above the so-called sparking potential, no discharge actually will occur unless ions are present between electrodes.

1120 A Ten Channel Pulse-Height Analyzer, by E. W. Dexter. AECD-2255 (LADC-414; LAMS-573), May 28, 1947, decl. September 2, 1948. 30 p. Informal disposition. Document for sale by AEC.

This report describes an electronic device for recording voltage pulses according to their various amplitudes. The pulses are sorted into ten amplitude intervals so that ten points of a differential bias curve are obtained simultaneously. Pulses can be handled at rates up to 12,000 per minute. Provision is made for examining a complete distribution curve in large intervals or for examining the fine structure of a distribution.

1121 Exposure Meter For Photomicrography, by V. T. Clemens and S. S. Brar. AECD-2271 (ANL-4164), May 13, 1948, decl. September 2, 1948. 11 p. Informal disposition. Document for sale by AEC.

In photomicrographic work, the reproduction of the same exposure on the film is of prime importance. For this purpose an exposure meter has been developed; it is essentially a device for measuring the intensity of illumination with a light sensitive tube. The circuit includes one 868 phototube and two 6SJ7 vacuum tubes connected as triodes; the arrangement of the circuit is essentially of the bridge type (balance circuit). The principle of circuit operation is briefly outlined and the operational techniques discussed. The main advantage of this meter is its simplicity. An A.C. line may be used for operating voltages. One schematic diagram and 2 photographs are included.

1122 The Cathode-Ray Oscillograph in Industry, 3rd ed., by W. Wilson. London, Chapman and Hall, 1948. 252 p.

Certain advances that have become known since the previous edition of this book, such as those resulting from radiolocation research, are of interest to industry, and have called for modifications and extensions in several parts of the text. In Chapter II, for example, the section on fluorescent screens has been largely rewritten, and in Chapter IV a new section has been inserted on "Electrostatic versus Magnetic Deflection"; there are also a number of minor additions. The chapter headings are: general principles and design; detailed description; accessory circuits; modern types

of cathode-ray oscillograph; single deflection readings; differential tests; applications requiring a repeating time base; tests requiring a single-sweep time base; tests involving independent bases other than time; the recording of mechanical pressures and strains; the electron microscope; construction, operation, and maintenance.

1123 Circuit for Testing Efficiency of Geiger Counters, by G. E. Hagen and D. H. Loughridge. Review of Scientific Instruments 19, p. 526-528, August 1948.

Design and operating characteristics of an electronic device for measuring over-all efficiencies of Geiger counters are provided. The device will rapidly, and without any standard tube, yield these data as well as provide a means of checking the relative sensitivity of various sections of a counter tube.

1124 Electron and Nuclear Counters: Theory and Use, by Serge A. Korff. New York, Van Nostrand; London, Macmillan, 1948. 4th printing. 212 p.

1125 An Electronic Fluxmeter, by R. H. Dicke. Review of Scientific Instruments 19, p. 533-534, August 1948.

This fluxmeter used the same principle of operation as the one described by R. F. Edgar (Electrical Engineering 56, p. 805, 1937); its performance is similar to the familiar Grassot meter. The properties of this fluxmeter are listed as follows: Accuracy; Determined essentially by the accuracy of a precision resistor and capacitor, also the output voltmeter. Sensitivity; Two ranges — 10,000 and 100,000 Maxwells/volt. Search coil; Resistance up to 10,000 ohms. Speed of response; Limited essentially to the response time of the output voltmeter. Rate of decay of reading; 0.06 percent/second with sensitivity of 100,000 Maxwells/volt. The operation of the instrument is briefly described; a schemetic diagram is given.

1126 The FP-54 As A Stable Voltage Amplifier, by N. T. Seaton. Canadian Journal of Research 26F, p. 302-309, July 1948.

A very simple method is given for operating the FP-54 Pliotron as a stabilized voltage amplifier with a grid current of less than 10^{-17} amp. The application of the method in the construction of a compact protable electrometer is discussed briefly. 8 references.

1127 A New Counter Tube Discharge Process, Obtained with Strongly Ionizing Particles, by P. Huber, W. Hunzinger, and E. Baldinger. Helvetica Physica Acta 20, p. 525-527, 1947. (In German).

Some experiments were carried out with a polomium alpha-particle source in a special double Geiger-Müller counter. It appears that alpha particles travelling radially give rise to abnormally large pulses; the phenomenon is considered to be caused by heavy primary (alpha particle) ionization which tends to cause space charge neutralization, which is in contrast with normal Geiger discharge.

1128 A New Quenching Circuit for Geiger Counters, by H. Maier-Leibnitz. Review of Scientific Instruments 19, p. 500-502, August 1948.

A quenching circuit is described that works on the multivibrator principle but uses two different grids of the input tube for the signal and for the regenerative feedback. The initial discharge in the counter excites the counter to one oscillation during which the counting voltage is kept below threshold and the counter has time to recover. At the end of the oscillation (after about 0.2 millisecond) the countervoltage and all other voltages are rapidly restored to their initial values. Thus the next count will take place under exactly the same conditions as the first; all amplifier pulses will be equal; no discharges will take place in the Geiger counter while the amplifier is unable to quench them; and corrections for dead time will be quite simple.

1129 A New Source of Electrons and Its Inversion as a Source of Ions (Une Nouvelle Source d'Electrons et Son Inversion comme Source d'Ions), by R. Keller. Helvetica Physica Acta 21, p. 170-172, 1948. (In French)

By adding an opening and an accelerating electrode to Penning's (Physica 4, p. 71, 1937) manometer an indestructible and very monochromatic electron source was made. By reversing the electrode polarity, the apparatus serves as an ion source. Instantaneous ion currents of 15 milliamperes and mean currents of 0.7 milliamperes were obtained with hydrogen. By using deuterium a source of neutrons is obtained, and using a velocity selector measurements can be made with slow monokinetic neutrons. A diagram of the apparatus is given.

1130 On Cloud Chamber Valves, by Fu-Hsing Chu and G. E. Valley. Review of Scientific Instruments 19, p. 496-499, August 1948.

An investigation of the factors which influence the opening time of Fussell-type cloud-chamber valves has been made. In particular, the action of auxiliary triggering coils has been examined. The following conclusions were made: The trigger-coil system allows the valve to open as fast as the available force can open it. This system is completely reliable, and it decreases the variation in opening time with magnet current and with pressure. Permanent magnet valves are practicable, and show no deterioration of the magnet after several thousand cycles of operation. Furthermore, they remain closed in case of power failure and require a minimum of power. The magnetic and electrical characteristics of the valve are not critical unless opening times shorter than 0.001 second are desired. The only ways to make it practical to seek opening times of 0.001 second or less are to decrease the mass of the moving element or to increase the accelerating force. Type SN4 strobotron tubes require illumination if they are to function reliably when triggered at infrequent intervals. Valves released by the trigger coil device often require another mechanism to keep them from closing too quickly. Simple dash-pot devices have been constructed for achieving this. There is no loss in performance when the capacitance is made up of electrolytic capacitors.

1131 A Remote Reading Dial Micrometer, by M. B. Coyle and F. G. Haynes. Journal of Scientific Instruments and of Physics in Industry 25, p. 275-276, August 1948.

An instrument, compact, reasonably insensitive to vibration, free from drift and instability, and able to be left unattended for 12 hours or more, was developed. The reading of a dial instrument may be transmitted electrically to a recording potentiometer, and no interference with the direct reading is indicated.

1132 Some Geiger-Muller and Proportional Counters of Spherical Shape, by Giorgio Salvini. Review of Scientific Instruments 19, p. 494-496, August 1948.

A Geiger-Müller counter with a spherically shaped cathode is described. The pulse shape from this counter is similar to that of cylindrical counters. It may be used satisfactorily in ordinary coincidence work. Some of the counters, slightly modified to avoid spurious discharge, were filled with boron trifluoride and used as proportional counters for detection of neutrons.

1133 The Velocity of Discharge Propagation in Geiger Counters, by A. J. Knowles, C. Balakrishnan, and J. D. Craggs. Physical Review 74, p. 627-628, September 1, 1948.

Measurements were taken with externally quenched counters containing hydrogen. The new method employed makes use of a 4-mc/sec and quartz-controlled oscillator. Results of argon/ethyl alcohol-filled tubes are shown.

ISOTOPE SEPARATION

1134 Approach to Equilibrium by a Thermal Diffusion Column. Part I. Column Closed at Both Ends, by H. M. Moseley and Nathan Rosen. AECD-2236, n.d., 11 p. decl. August 25, 1948. For publication in Physical Review and for informal disposition.

Calculations have been carried out for the separation factors of the thermal diffusion column approaching equilibrium for the case in which the column is closed at both ends and the concentration of the isotope to be enriched is small. The results are presented in tables and graphs. Suggestions are made for using these results to determine the characteristic constants of a column from experimental data on approach to equilibrium.

1135 Separation of Nuclear Isomers, by W. S. Koski. AECD-2262 (LADC-502), n.d., decl. September 2, 1948. 3 p. For publication in Physical Review.

An electrolytic separation of the 4.4-hour and 18-minute bromine isomers of n-butyl bromide is discussed. The mixture of the isomers was dissolved in acetone, and silver electrodes, separated by a distance of about 4 mm and at an emf difference of 10 volts, were placed in the solution. The electrodes were removed after 15 seconds. Both electrodes were radioactive, and a study of the decay curve showed an enrichment of the 18-minute bromine isomer over the equilbrium value before electrolysis. The anode had an activity greater by a factor of ten than the cathode. Increasing the voltage gave a greater activity and a more efficient separation on the anode. The fact that the bromine isomer can be separated in this fashion indicates that an appreciable fraction of 18-minute bromine isomer appears as negative ions. The results of this study are compatible with those published by Roussinow and Karamain (Doklady Akademii Nauk URSS 55, No. 7, p. 603-605, 1948; and 58, No. 4, p. 573-574, 1947.).

LABORATORIES

1136 British Atomic Plant Unveiled. Chemical Engineering Progress 44, No. 9, p. 24, September 1948. (News Section).

A brief description is given of the two operating British piles. In addition to the Harwell installation there are four other establishments concerned with the development of atomic energy: the design headquarters at Risley, a uranium ore refining plant near Preston, a pile establishment at Sellafield, and a radio chemical center at Amersham.

MASS SPECTRA

1137 The Use of Probes for Plasma Exploration in Strong Magnetic Fields, by D. Bohm, E. H. S. Burhop, and H. S. W. Massey. AECD-2230 (BP-46), n.d., decl. August 26, 1948. 85 p. For publication in NNES.

Experimental studies of probe characteristics for an arc plasma in a uniform magnetic field are described. Details of the equipment used, including arc chambers and probes, are given. The studies were carried out using argon, nitrogen, and chlorine. The values obtained for the ratio of electron saturation current to positive ion saturation current are appreciably lower than those predicted by ordinary probe theory. A theory of probes used in a magnetic field is presented with a view to explaining the results obtained experimentally. In the case of positive ions, taking into effect gas-kinetic and electric effects, the theory indicates that under conditions recurring in practice the positive ion collection is determined not by the positive ion temperature but mainly by the electron temperature. Electron collection has been treated on the basis of electron diffusion, both collision and drain diffusion being considered. The collision diffusion fails to explain the experimental results obtained. On the other hand, drain diffusion theory gives the right order of magnitude for the ratio of electron saturation current to positive ion saturation current. However, this theory does not predict in detail the changes in the ratio with such variables as ion density and arc current. It is pointed out that the presence of oscillations in the arc plasma has a strong effect on the rate of diffusion of electrons at right angles to the direction of the magnetic field.

MASS SPECTRA

1138 A Special Case of Velocity Focusing in a Magnetic Field, by J. Koch. Konelige Danske Videnskabernes Selskab, Matematiske-fysiske Meddelelser 24, No. 7, 1948. 22 p. (In English)

A compensation for the effects of small fluctuations of accelerating voltage in a mass spectrometer using a wedge-shaped magnetic field was made by applying a transverse deflecting electric field proportional to the fluctuation between the ion source and the magnet. A graphical method for determining the constant of proportionality is developed.

1139 A Time-of-Flight Mass Spectrometer, by S. A. Goudsmit. Physical Review 74, p. 622-623, September 1, 1948.

A mass spectrometer making use of the constancy of the time of flight in a magnetic field is suggested. This will be best suited for the determination of the relative masses of heavy elements.

METALLURGY

1140 The Beryllium - Iron System, by Robert J. Teitel. AECD-2251, April 1948, decl. September 1, 1948. 135 p. For informal disposition and for publication in a technical journal.

One of the recent additions to the list of important elements in the metallurgical field is beryllium. At first, it was used to improve the mechanical properties of some of the common metals. However, now with the development of atomic energy, interest in beryllium and beryllium-rich alloys has also come to the fore.

In this document the alloys of iron and beryllium are discussed primarily from the standpoint of the equilibrium diagram. Iron has been selected because (1) it ranks first in all-around importance in metallurgy, (2) beryllium may be a useful alloying element in iron and steel, and (3) it is known that the iron-beryllium system is quite complex and may provide new information for the theory of intermediate phases and phase transformations. Special vacuum furnaces, beryllia crucibles, and thermal controls were developed to carry out thermal analysis and quenching experiments.

The best avialable beryllium (99.4% Be) was sufficiently impure to exhibit a double arrest at the freezing point. After discarding the possibility of an allotropic transformation, the impurity was found to cause the anomaly. This meant that the section determined from the data was that of a ternary and the binary had to be deduced from the ternary section. This interpretation was needed only at the high beryllium end of the diagram.

The solid phases in the beryllium-iron system have been identified as follows:

Phase	Formula	Lattice Structure	No. of atoms per cell	Lattice Dimensions(A°) a	c	c/a	Density (g/cc)
Be	Be	Hex. C.P.	2	2.281	3.577	1.568	1.841
β	$FeBe_{11}$	Hex. C.P.	18	4.130	10.424	2.524	2.474
θ	$FeBe_5$	F.C.C.	24	5.884			3.241
ϵ	$FeBe_2$	Hex. C.P.	12	4.212	6.853	1.626	4.572
α-Fe	α-Fe	B.C.C.	2	2.861			7.871

The beryllium-iron system contains two eutectics, one at 1225°C: $L_{4.0} \rightleftharpoons Be_{0.4} + \theta_{6.8}$ (subscripts indicate composition of phase in atomic per cent iron) and the other at 1165°C: $L_{64.0} \rightleftharpoons \alpha\text{-}Fe_{66.5} + \theta_{37.5}$. There is also a peritectic at 1375°C: $L_{16.5} + \epsilon_{20.9} \rightleftharpoons \theta_{18.0}$ and an eutectoid at 1010°C: $\theta_{7.0} \rightleftharpoons Be_{<0.1} + \beta_{7.8}$. The β phase decomposes congruently into θ on heating at 1075°C; and the ϵ phase melts congruently at 1480°C. There are wide ranges of homogeneity in the θ, ϵ, and α-Fe phases, but very limited solubility in the Be and β phases. Most of the solubility limits were determined by x-ray and microscopic analysis. 19 references.

METALLURGY

1141 Plastic Bonding of Boron Powder, by L. Hays and J. E. Burke. AECD-2279 (LADC-152), October 4, 1944, decl. September 13, 1948. 4 p. Informal Disposition.

This report describes a method for bonding boron powder by wet-tamping it with methyl methacrylate monomer and polymerizing the monomer to produce a finished piece which has a boron density of at least 1.6. The method has the advantage that almost any shape can be made without constructing expensive dies or using a press. It should be possible to bond other materials in the same fashion and obtain comparable percentages of the density of the pure solid.

1142 The Consolidation of Boron, by F. G. Stroke. AECD-2291 (LADC-140), August 23, 1944, decl. September 17, 1948. 24 p. Informal Disposition.

Methods of consolidating boron and boron carbide into compacts that possess certain desired physical properties were investigated. For production fabrication of boron, the hot-pressing method appeared best. Boric anhydride and lead borate glass worked well as bonding agents. Plastic bending was found to have advantages as a method of consolidation. The various methods including metal bonding, impregnation, hot pressing, and plastic bonding are described in detail and experimental results summarized.

1143 A Rare Metal in Everyday Use, by M. Schofield. Discovery 9, p. 244-246, August 1948.

This article is a general review of the uses and properties of tantalum.

MINERAL RESOURCES

1144 Radioactive Minerals in Ontario. Mining Magazine 79, p. 124-126, August 1948.

A report by N. Hogg recently issued by the Ontario Department of Mines describes the "Mosher Discovery of Radioactive Mineral, Pitt Township, District of Cochrane." The most important source of radioactivity exposed at the present time is a carbonate vein, of which more than 75 per cent is carbonate, with the remainder made up of felspar, mica, and hematite. The vein at the time of the examination was exposed over a length of 240 ft. Three samples from the Mosher vein were submitted for testing to the Provincial Assayer and returned U_3O_8 equivalents of 0.03, 0.12, and 0.055 per cent.

1145 Titanium among Canada's Mineral Wealth, by A. W. J. Dyck. Canadian Chemistry and Process Industries 32, p. 717, August 1948.

Vast deposits of titanium were discovered in northern Quebec at Lake Allard, promising to make the whole North American continent self sufficient with regard to titanium products. The ore is an ilmenite, containing 35-40 per cent TiO_2, 37 per cent iron, 3 per cent silica. A 27-mile railroad connecting the north shore of the Gulf of St. Lawrence with the ore-bearing area and a refinery for electrolytic separation will be built.

NUCLEAR PHYSICS

1146 Introduction, Volume XVI, Division II, National Nuclear Energy Series, by M. Benedict and C. Williams. AECD-2229, n.d., decl. September 1, 1948. 4 p. For publication in NNES.

This introduction to volume XVI of the NNES briefly refers to the following subjects: special plant instruments; vacuum engineering; development of heat transfer equipment; and absorption of UF_6 and fluorine.

NUCLEAR PHYSICS—METHODS OF MEASURING

1147 Radioactivity Measurement Techniques, by James H. Pannell. AECD-2270, n.d., decl. November 13, 1947. 13 p. Oral presentation before a meeting of the American Association for the Advancement of Science. Document for sale by AEC.

Techniques and instruments employed in the measurement of radioactivity are discussed. These include autoradiographic methods using photographic emulsions, the electroscope, scintillation methods utilizing the fluorescence produced in various compounds by alpha particle impact, and the ionization chamber. The various types of Geiger counters that have been developed are discussed in some detail.

The energy of the emitted radiation must be considered when choosing a method for measuring the radio-activity of tracers; if greater than 100 Kev, Geiger counters are to be considered, unless the specific activity is such as to give counting rates of less than 100 per minute. The activity of the important tracers C^{14}, I^{131}, P^{32}, and S^{35} may be detected by Geiger counters; I^{131} also emits gamma radiation, which permits its detection in vivo. Qualitative and semiquantitative determinations of weaker alpha and beta particles can be carried out in a Lauritzen electroscope, while utmost precision can be attained with an ionization chamber employing "infinitely thin" sources.

1148 Observations of Naphthalene Scintillations Due to Tritium Beta Rays, by R. F. Taschek and H. T. Gittings. AECD-2273 (LADC-552), n.d., decl. September 2, 1948. 4 p. For publication in Physical Review as a letter to the Editor.

Preliminary observations on the scintillations produced in commercial naphthalene by the beta rays from tritium and by the bremsstrahlung coming from tritium occluded in tantalum is reported. In one case, gaseous tritium was placed in contact with finely powdered naphthalene crystals; in the other experiment, a tantalum disc containing occluded tritium was placed near solid naphthalene to investigate the effect of soft x-rays since this is an almost pure source of such radiation. Time rise and total pulse length using a 1P21 photomultiplier, a Los Alamos Model 501 amplifier, and a 248A Dumont scope were respectively 0.05 microseconds and 0.2 microseconds.

Individual pulses down to at least 10 Kev beta energy are believed to have been observed. The lower limit of the conversion efficiency from beta rays to visible light appears to be about 3%. The authors speculate that in view of the comparatively large energy conversion and the possibility of increasing the light collected by a factor of five, this method can be used to study beta ray spectra.

1149 Distant Counting of Scintillations, by E. P. Blizard, and S. DeBenedetti. AECD-2284, n.d., decl. September 15, 1948. 1 p. For publication in Review of Scientific Instruments as a letter to the editor.

This is not an abstract; the document is reproduced below in its entirety.

Two limitations to the use of scintillation counters with photomultipliers are; a) the photomultiplier will not operate in strong magnetic fields, b) the pulse height distribution is perturbed by the direct response of the multiplier to radiation. These limitations can be circumvented by separating crystal and photomultiplier, and focussing or canalizing the scintillation light. To test this point an anthracene sample was mounted at the focus of a hemispherical mirror 1 5/8" dia. at one end of an internally reflecting tube of equal diameter and one meter long. A liquid nitrogen cooled 1P21 photomultiplier was placed at the other end, and the whole assembly made light-tight. With this arrangement we could count with 100% efficiency the alpha particles from a polonium source in contact with the anthracene. With 80 volts per stage, the alpha particle pulses were much larger than those of the photomultiplier background. Under the same conditions, the efficiency for beta rays of E_{max} = 0.87 Mev was also 100% within the limits of accuracy of source calibration. Satisfactory results were also obtained with dry ice cooling; with improved optical techniques it might be possible to dispense with cooling altogether.

NUCLEAR PHYSICS — METHODS OF MEASURING

1150 The Application of a Magnetic Lens Spectrometer to the Measurement of Gamma Radiation From Zn^{65} and Co^{60}, by Erling N. Jensen, L. Jackson Laslett, and William W. Pratt. AECD-2286, n.d., decl. September 17, 1948. 24 p. For publication in Physical Review. (See also AECD-1836).

A thin magnetic-lens spectrometer for the investigation of gamma-ray spectra is described. The effect of the thickness of the radiator used for the production of photoelectrons and the influence of the earth's magnetic field are reported. Based on a calibration of the instrument by means of annihilation radiation and the F line of ThB, energy values of 1.106 Mev for the gamma-ray of Zn^{65}, and 1.115 and 1.317 Mev for the two lines of Co^{60} are obtained. The probable error is estimated at 0.5 per cent.

1151 Anomalous Distribution of Nuclear Disintegration in Photographic Emulsions Exposed to Cosmic Rays: Double Stars, by L. Leprince-Ringuet and J. Heidmann. Nature 161, p. 844, May 29, 1948.

An anomaly was noticed in the distribution of nuclear disintegrations occasioned by exposing Ilford plates to cosmic rays at 3600 m. The anomaly is explained by the supposition that one star of a pair has produced the other through the medium of a particle which is invisible in the emulsion such as a neutron, neutral meson, photon, electron, fast proton or fast charged meson. This would explain the anomalously large number of pairs with a center distance less than 100μ.

1152 Photographic Plates for Use in Nuclear Physics, by J. H. Webb. Physical Review 74, p. 511-532, September 1, 1948.

The registration of charged particles by the photographic emulsion is considered from the standpoint of their space rate of energy loss on passage through matter. On the basis of the highest-energy particles that can be recorded as recognizable tracks, an energy-loss value of 0.013 Mev per cm of air path is taken as an approximate threshold sensitivity value of the best present-day nuclear-particle emulsions. This energy-loss value corresponds to alpha particles of energy less than 400 Mev, deuterons of 100 Mev, protons of 50 Mev, and electrons of 20 Kev. Some evidence is cited to show that these limiting energy values are in accord with experience.

Range-energy curves for alpha particles, protons, deuterons, and mesons in high silver halide concentration emulsions are given, based on constant stopping-power values of the emulsion. A relative stopping-power value of 1800 is used for alpha particles, and a value of 2000 is used for protons, deuterons, and mesons. Data on the composition, physical characteristics, and sensitivity, and also recommended uses of some of the commercially available nuclear-particle emulsions are presented. A theoretical calculation of the stopping power of the photographic emulsion relative to that of air is given. Curves of stopping power versus energy for alpha particles and protons in a high silver halide content emulsion are calculated and compared with published experimental values.

Grain density and its variation in the recorded tracks of nuclear particles in the photographic emulsion are discussed. It is pointed out that the grain density for low-energy particles approaches a maximum value determined by the grain population of the unexposed emulsion. A qualitative discussion is given to show why grain spacing varies with particles of differing ionizing power. Finally, the mechanism of latent-image formation is considered from the standpoint of ion-pair production in the grain. Using the energy-loss value of 0.013 Mev per cm as a threshold limit and a value of 7.6 ev for the energy required to produce an ion pair in silver bromide, it is shown that about 150 ion pairs must be produced in a single grain to form the latent image. Typical photomicrographs are given. 38 references.

NUCLEAR PROPERTIES

1153 Rotation Vibration Levels of the Fe^{57} and Ni^{59} Nuclei, by H. A. Wilson. Physical Review 74, p. 351, August 1, 1948.

The resonances for neutron scattering with Fe^{57} and Ni^{59} appear to be rotational vibration levels. To support this conclusion tables are given showing a rather close correlation between observed resonances (Barschall et al., Physical Review 73, p. 659, 1948) and rotational vibration levels calculated from the formula $15 + 5[j(j+1) - 3/4]$ for iron and $15 + 4.1[j(j+1) - 3/4]$ for nickel. From moment of inertia data the nuclear radius, r, for Fe^{57} was calculated as 10.6×10^{13} cm; for Ni^{59} as 11.0×10^{-13} cm.

1154 Rotation Vibration Levels of the Si^{28} and Al^{28} Nuclei, by H. A. Wilson. Physical Review 74, p. 352, August 1, 1948.

Tables are presented which indicates that several of the $Al^{27}(p,\gamma)Si^{28}$ resonance levels measured by Brostrom, et al. (Physical Review 71, p. 661, 1947) can be explained as belonging to the rotation vibration levels of the Si^{28} nucleus. Too, some of the $Al^{27}(n,\gamma)Al^{28}$ resonances measured by Seagondollar and Barschall (Reviews of Modern Physics 19, p. 271, 1947) appear to be rotation vibration levels of the Al^{28} nucleus.

1155 Spin and Quadrupole Moment of S^{33}, by C. H. Townes and S. Geschwind. Physical Review 74, p. 626-627, September 1, 1948.

Quadrupole effects caused by S^{33} in OCS were found and show that the spin of S^{33} is 3/2 and that its quadrupole moment is negative. A hyperfine structure was found in the OCS^{33} absorption line $J = 1 \longrightarrow 2$. A table of frequencies and intensities of the lines is given. The weakest observed line $(F = 3/2 \longrightarrow 1/2)$ has a peak absorption coefficient of 5×10^{-9} cm^{-1}. The quadrupole coupling constant is -28.5 ± 0.7 mc and the mass ratio $S^{33} - S^{32}/S^{34} - S^{32}$ can be determined to be 0.5006 ± 0.00015.

NUCLEAR THEORY

1156 Determination of the Masses of Charged Particles Observed in the Photographic Plate, by Y. Goldschmidt-Clermont, D. T. King, H. Muirhead, and D. M. Ritson. Proceedings of the Physical Society 61, Part 2, p. 183-194, August 1, 1948.

Using a mechanized projection microscope, a magnification of 4000, and a new method for increasing the effective number of measurements on a single track, the authors studied the scattering of 40 protons and 160 mesons in photographic emulsions in order to determine the mass of the individual particles. A large spread of values is obtained, but the majority of mesons can be identified with the mesons of the order of 200 m_e, commonly observed with counters and in cloud-chamber experiments, as well as with the μ-mesons observed in the photographic plates.

The slow particles producing nuclear disintegrations, and the mesons appear to contain a large proportion of particles with a mass equal to that of π-mesons. The results of the mass determinations on 20π-, 20μ-mesons, 60σ-, and 60ρ-mesons are: mass of π-mesons: 260 ± 30 m_e; mass of μ-mesons: 205 ± 20 m_e; mass of σ-mesons: 275 ± 15 m_e; mass of ρ-mesons: 200 ± 10 m_e. The mass ratio of π- to μ-mesons from grain counting is 1.3 ± 0.2, as compared to the best value recorded in the literature of 1.66 ± 0.11 (Lattes et al., Proceedings of the Physical Society 61, Part 2, p. 173-183, August 1, 1948. Histograms for the various particles are given.

1157 The Interaction of Nuclear Electric Quadrupole Moments with Molecular Rotation in Asymmetric-Top Molecules. Part I, by J. K. Bragg. Physical Review 74, p. 533-538, September 1, 1948.

The theory of the interaction of nuclear electric quadrupole moments with molecular rotation is extended to asymmetric-top molecules containing one or two quadrupolar nuclei. The first-order theory is developed in detail in a form which makes use of published numerical tables of line strengths

NUCLEAR THEORY

of asymmetric-top pure rotation transitions and involves the second derivatives of the electrostatic potential V taken along the three principal axes of inertia. Only two of these are independent, and $(\delta^2 V/\delta z'^2)$ and $(\delta^2 V/\delta x'^2)-(\delta^2 V/\delta y'^2)$ are a convenient choice of the parameters of the problem. A general formulation of the theory, which includes higher order effects, is given. In case a molecule contains only one quadrupolar nucleus, the structure of the quadrupole multiplets should be sufficient to identify pure rotation transitions.

1158 The Meson Field and Equations of Motion of Point Particles, by R. C. Majumdar and A. S. Apte. Physical Review 74, p. 538-547, September 1, 1948.

The equation of motion of a point particle possessing a charge and interacting with a meson field (both vector and scalar) is derived from a generalization of the scheme of Infeld and Wallace (Physical Review 57, p. 797, 1940) for determining the equation of a point electron in an electromagnetic field. The retarded and advanced meson fields of the point particle and the nature of the simultaneous expressions for symmetric, 1/2(ret + adv), and radiation, 1/2(ret − adv), potentials and field intensities are investigated. The simultaneous radiation field is found to be always finite for $r \longrightarrow 0$, whereas the corresponding symmetric field allows expansion in powers of r with −2 as the lowest, r being the radius of the 3-dimensional sphere surrounding the singularity which represents the point particle. It is shown that the removal of the singularities from the symmetric field leads to the equation of motion given by Bhabha (Proceedings of the Royal Society 172A, p. 384, 1939) for the vector meson field in the case of the retarded field; the symmetric field, on the other hand, leads to the equation of motion in which the radiation damping is absent. The corresponding equation of motion of a point particle in a scalar meson field is also given.

1159 On the Problem of the Mass Stability of the Elementary Particles, by H. Honl, Zeitschrift für Naturforschung 2A, p. 537-549, October 1947. (In German).

Using radiations reaction terms the motion of a particle of the type mass-point plus mass-dipole is calculated. As in the case of the Dirac classical electron in which mass-point only is involved, self-acceleration occurs; however the parameters involved do not depend on the charge. The particle is described as a heavy unstable particle of spin $h/2\pi$ which is capable of spontaneously disintegrating into two particles with spin $h/4\pi$.

NUCLEAR TRANSFORMATION

1160 The Cross Section for the Reaction D(T,α)n, by C. P. Baker, M. G. Holloway, L. D. P. King, and R. E. Schreiber. AECD-2226 (LADC-540), September 17, 1943, decl. August 10, 1948. 44 p. Informal disposition. This includes declassification of the disintegrating chamber.

This is a final report on the measurements made of the cross section for the reaction D(T,α)n for incident energies of tritons between 0.3 and 1.0 Mev using a target about 0.2 Mev thick. The measurements, made in a cone of approximately 30° about the direction of the beam, give a thick target cross section, which increases with increasing energy to a maximum value of 2.1 barns at 0.32 Mev and decreases to a value of 0.6 barns at 0.9 Mev. Measurements made in a zone at right angles to the direction of the beam indicate a peak value of 2.8 barns also at 0.32 Mev and a value of 0.7 barns at 0.9 Mev. These last values are subject to corrections for final calculations of the solid angles.

1161 Preliminary Results on the Cross-Section of the Reaction $T^3(d,n)He^4$ between 1.0 Mev and 2.5 Mev Deuteron Energy, by Richard Taschek. AECD-2250 (LADC-510), February 3, 1948, decl. August 31, 1948. 20 p. For publication in Physical Review.

The reaction $T^3(d,n)He^4$ has been studied for deuterons of energies 1.0 Mev to 2.5 Mev (triton energies $3/2\ E_d$) both to determine the differential and total reaction cross sections and to study the use of this reaction as a source of high energy neutrons.

NUCLEAR TRANSFORMATION

The availability of small but sufficient quantities of tritium made the acceleration of deuterons of energies above 1 Mev on to gaseous tritium seem the logical method of producing the reaction and observing the reaction products, alpha particles and neutrons. A special target allowing angular distribution measurements of alpha particles to be made in a small gas volume is described and the essentials are indicated. A schematic diagram of the tritium storage and handling system is shown; heated uranium shavings provided a completely satisfactory method of evolving the tritium stored as UH_3 in the cold uranium when not in use. Since the total amount of gas available at one time was only about 10 to 15 cm^3 at NTP, the mercury lift through the 500 cm^3 bulb was used to make a complete transfer of gas at maximum efficiency from uranium pump to target and vice versa possible. Auxiliary connections could be made to supplies of hydrogen and deuterium gas as shown in the diagram.

The following total reaction cross sections are reported: 0.15 ± 0.02 barns at 1.0 Mev, 1.5 Mev and 2.0 Mev; 0.135 ± 0.03 barns at 2.5 Mev. This last cross section is believed to be inaccurate because of unsatisfactory measurements.

NEUTRONS

1162 The Use of the Uranium Reactor in Radiochemical Studies, by R. T. Overman and J. A. Swartout. AECD-2245, n.d., decl. August 31, 1948. 19 p. For oral presentation at a meeting of the American Chemical Society, Portland, Oregon, September 16, 1948. (See also AECD-2181).

An abstract of this document was given the number AECD-2181. The abstract was listed in Nuclear Science Abstracts as No. 976.

1163 On the Application of Neutron Techniques to the Experimental Investigation of the Low Temperature Properties of He^3 or He^4-He^3 Systems, by L. Goldstein. AECD-2259 (LADC-546), June 21, 1948, decl. August 31, 1948. 6 p. For publication in a technical journal.

It is shown that the low temperature properties of pure He^3 or He^3-He^4 mixtures may be investigated using neutron transmission techniques with these fluids. This would eliminate the difficulties encountered in such experiments, where currently the vapor and liquid samplings for mass spectrography of the He^3-He^4 mixtures in thermodynamic equilibrium, seem to destroy the latter. The interpretation of the data becomes thereby confused, if not wholly impossible. The suggested method should lead to experimental accuracies which cannot be attained with present day techniques used in the studies of the low temperature properties of these helium mixtures.

1164 Scattering of Neutrons by Polycrystals, by R. G. Sachs. AECD-2269, n.d., decl. August 8, 1947. 13 p. For use in lectures and seminars. Document for sale by AEC.

The scattering of neutrons by polycrystals is treated mathematically. If the neutron wave length, given by the de Broglie equation $\lambda = h/mv$, is comparable to the spacing of atom planes in a uniform single crystal lattice, diffraction peaks can be expected similar to those occurring for x-ray diffraction phenomena. The scattering of neutrons by polycrystals is considered from the view of simple wave optics. Equations are developed which clearly set in evidence the physics of the process.

1165 Tables of Neutron Cross Sections, by K. Way and G. Haines. AECD-2274 (MonP-405), October 28, 1947, decl. July 22, 1948. 217 p. Informal disposition. Document for sale by AEC.

These tables of neutron cross sections constitute a summary of the data available on the subject up to September 1, 1947, for elements from hydrogen through bismuth. For each element, cross sections are given for slow neutrons (40 ev and less) and fast neutrons (over 40 ev). Cross section data for the various elements are divided into total, scattering, and absorption cross sections. Stable isotopes

NEUTRONS

and radioactive isotopes which can be made by neutron bombardment are listed. Abundance data for stable isotopes and decay schemes for many radioactive nuclei are presented. An extensive bibliography is included.

1166 Effect of the Temperature of the Moderator on the Velocity Distribution of Neutrons with Numerical Calculations for H as Moderator, by E. P. Wigner and J. E. Wilkins, Jr. AECD-2275 (CP-2156), September 14, 1944, decl. September 13, 1948. 17 p. For publication in a technical journal.

An integral equation is set up governing the energy distribution of neutrons which are being slowed down uniformly throughout the entire space by a uniformly distributed moderator whose atoms are in motion with a Maxwellian distribution of velocities. The effects of chemical binding and crystal reflection are ignored. When the moderator is hydrogen, the integral equation is reduced to a differential equation and solved by numerical methods. In this manner a refinement of the dv/v^2 law is obtained.

1167 The Variation With Neutron Energy of the $n(He^3,p)H^3$ Reaction Cross Section, by L. D. P. King, E. S. Robinson, L. Goldstein, and F. L. Bentzen. AECD-2281 (LADC-558), n.d., decl. September 8, 1948. 1 p. For publication in Bulletin of the American Physical Society.

This document is an abstract; it is reproduced below in its entirety.

The total neutron absorption cross section of He^3 was compared with that of B_{10} enriched BF_3 gas in the approximate energy range of 0.025 - 0.001 electron volts. The constancy of the product σ times v, v denoting the neutron velocity, has been established for He^3 in this energy range. This "1/v" variation of the total cross section refers to the $n(He^3,p)H^3$ reaction as established by Coon and Hughes. This law points toward the apparent existence of a broad excited level in the He^4 nucleus whose energy is some 20 Mev above its ground state.

1168 Angular Distribution of 14-Mev Neutrons Scattered by Protons, by R. F. Taschek, H. H. Barschall. AECD-2292 (LADC-557), n.d., decl. September 8, 1948. 1 p. For publication in Bulletin of the American Physical Society.

This document is an abstract; it is reproduced below in its entirety.

Monoenergetic 14-Mev neutrons were produced by bombarding a tritium target with 200-Kev deuterons. Proton recoils originating in a thin polythene radiator could pass through three proportional counters arranged in a direction perpendicular to the radiator, and coincidences in the three counters were observed. By rotating the foil and counters about the center of the foil, the angular distribution of the recoiling protons could be measured. The angular resolution was $\pm 12°$ in the center of mass system. Protons corresponding to neutrons scattered through 90°, 120°, 150°, and 180° in the CM system were observed. Within the statistical accuracy of five per cent at each angle, the angular distribution of the scattered neutrons appeared isotropic in the center of mass system.

PARTICLE ACCELERATORS

1169 General Equipment and Techniques. The Modulated Betatron, by D. Kerst. Modulation and Other Tendencies Used With Ion Accelerators, by B. D. McDaniel, L. S. Lavatelli, and E. Graves. AECD-2287 (LADC-516), December 15, 1947, decl. September 20, 1948. 122 p. For inclusion in NNES, and informal disposition.

The Modulated Betatron. The name "betatron" has been given to an electron accelerator which operates upon the principle of giving energy to electrons constrained by a magnetic field to move in a nearly circular closed orbit, by means of the electromagnetic induction effect of increasing the magnetic flux through the orbit. Topics discussed in detail are elementary theory of the betatron, betatron structure and adjustment, and the production of single x-ray pulses in the betatron.

PARTICLE ACCELERATORS

Modulation and Other Techniques Used With Ion Accelerators. The following types of cyclotron modulations are discussed: arc modulation of a cyclotron beam, deflector modulation for a cyclotron, modulation of the dee voltage of a cyclotron, and the obtaining of a point neutron source from a cyclotron with a very low background of intensity from any points other than this source ("snouting" the cyclotron beam). Modulation techniques used with the Cockcroft-Walton and Van de Graaff types of accelerators are also covered in this report. Other topics discussed are the various methods of monitoring accelerator beams, and neutron spectrometer techniques involving the modulation of the neutron source (the cyclotron in this particular case) and the detector. Photographs of various types of particle accelerators and their components, and numerous schematic diagrams explaining modulating techniques are included.

1170 The Accelerator Conference, by E. Alfred Burrill. Physics Today 1, No. 5, p. 12-16, September 1948.

A conference was held at the Massachusetts Institute of Technology, surveying the existing problems in the particle accelerator field and possible experiments to be conducted in it. New machines now under construction are, among others: two twelve-million-electron-volt electrostatic machines at the Massachusetts Institute of Technology and Los Alamos; two proton synchrotons, one for three billion electron volts at Brookhaven, and one at Berkeley for six billion volts.

1171 Electromagnetic Deflector for the Beam of the 184-Inch Cyclotron, by W. M. Powell, L. R. Henrich, Q. A. Kerns, D. C. Sewell, and R. L. Thornton. Review of Scientific Instruments 19, p. 506-512, August 1948. (See also MDDC-1560).

The removal of the ion beam of 190-Mev deuterons from the magnetic field of the 184-inch cyclotron is complicated by the fact that at large radii the ion increases its radius very little in one revolution. The usual type of deflector did not appear to be usable. Consequently, a pulsed electric deflector was designed that would give an additional radial oscillation to the ions which could be as much as seven centimeters. This permits deflection of the ions outward to a magnetic deflector which is outside the range of the circulating ion. The field is sufficiently reduced inside the magnetic deflector to permit the ions to leave the magnetic field of the 184-inch cyclotron. Approximately 0.5% of the circulating beam appears in the external beam.

1172 Experiments with an Arc Ion Source for the Cyclotron, by H. Atterling. Arkiv för Matematik, Astronomioch Fysik 35 A, Paper 32, 1948. 16 p.

An arc ion source used in connections with the 32-in. cyclotron in Sweden is described. The relations of ion output to electron emission and dee voltage was determined; the effects of various types of filaments, gas flows and arc currents were investigated. A very concentrated beam of electrons was obtained by beams of an indirectly heated tungsten point within the filament spiral. By means of a hooded arc deuteron currents to an internal target of 100-200 μA were obtained.

PHYSICS, GENERAL

1173 The Electrodeposition Behavior of a Simple Ion, by L. B. Rogers and A. F. Stehney. AECD-2239 (ORNL-99), January 15, 1948, decl. August 17, 1948. 11 p. For publication in Journal of the Electrochemical Society.

It is pointed out that the Nernst equation predicts that the position of the deposition curve, where percentage of element deposited versus potential is plotted should be independent of the amount of reducible element involved providing: (a) the "inert" electrode is incompletely covered with deposit, and (b) all other experimental factors are held constant. Furthermore, the equation predicts that the deposition curves should shift with changes in electrode area, volume of solution and size of the deposited atom (or aggregate). Any factor involving changes in the number of deposited atoms on the surface at the solution-electrode surface will also produce a shift. Another term must be added to the Nernst equation to account for energy changes originating at the deposit-electrode interface

PHYSICS, GENERAL

1174 Low Temperature Performance Tests on Rupture Diaphragms, by W. L. Richardson and G. S. Storer. AECD-2268, September 1945, decl. August 31, 1948. 12 p. Informal Disposition. This document for sale by AEC.

In order to determine the performance of rupture diaphragms at low temperatures, tests were made using silver and aluminum diaphragms of $\frac{1}{2}$ inch, and 1 inch, and 1-$\frac{1}{2}$ inch diameters. Charts are given showing bursting pressure in pounds per square inch at 68°, 32°, 0°, −25°, −50°, −75°, and −100°, all in Fahrenheit, for both types of diaphragms. Bursting pressure increases as the temperature decreases. Each diaphragm ruptured in a normal pattern. Photographs of the test bench and equipment, and of the diaphragms after rupture are included. A schematic diagram of the piping layout is given. The construction of the testing equipment is discussed.

1175 Introduction to the Differential Equations of Physics, by L. Hopf. New York, Dover, 1948. 154 p.

1176 The Specific Primary Ionization and Energy Loss of Fast Electrons in Matter, by Frank L. Hereford. Physical Review 74, p. 574-579, September 1, 1948.

The primary ionization by electrons in hydrogen has been determined for energies in the range 0.2 Mev to 9.0 Mev by utilizing the dependence of a Geiger-Mueller counter efficiency on the primary ionization of a counted particle. A magnetic focusing beta-ray spectrometer was employed in the range 0.2 Mev to 0.75 Mev, while for energies exceeding 0.75 a coincidence counter method was used. For electron energies in the 0.9 Mev to 2.5 Mev range, a radium source was used, while at higher energies the beta spectrum of B^{12} was employed in evaluating J. Using pressure as a parameter, plots are made of counts per minute versus energy. The curves are compared with the theoretical Bethe-Bloch curve.

The relative stopping powers of carbon and water have also been investigated, and evidence is given for the existence of a polarization effect, which reduces the energy loss of fast particles in condensed matter. The results were compared with the Halpern-Hall (Physical Review 57, p. 459, 1940; 73, p. 477, 1948) theory, which considers the polarization properties of the medium.

PUMPS

1177 An Improved 8 and 32 Inch Diffusion Pump Combination, by Gordon P. Brown. AECD-2231, October 3, 1946, decl. August 17, 1948. 18 p. For publication in NNES.

The original pump assembly is sketched. It consisted of a 32 inch high-vacuum pump, having three stages — a water cooled baffle and an 8 inch booster pump sharing the backing from a 100 cfm pump with two other such assemblies. Originally both the high vacuum and booster pumps were made fractionating with an interconnecting oil line between the two boilers to take care of any oil migration. The speed of the 32 inch pump was measured as 10,000 liters per second without the baffle and 8,400 liters per second with the baffle. Comparison of this figure with that for a good 8 inch diffusion pump, on an overall basis, indicated that a speed of at least twice this figure could be expected.

Modifications of the original assembly were: decreasing baffling, increasing distance between the first and second jet, decreasing distance between the second jet and wall, and decreasing distance between the bottom jet and wall. A sketch of the improved pump assembly is given and its operating characteristics discussed. In an appendix, rates of leak measurements in determining capacities of diffusion pumps are discussed.

1178 Vacuum Pump. Review of Scientific Insturments 19, p. 538, August 1948.

A new two-stage duo-seal vacuum pump has a free air capacity of 300 liters per minute and a guaranteed vacuum of 0.1 micron, with a possible vacuum of 0.03 microns as tested. At a pressure of 1.0 micron, the flow rate is 152 liters per minute.

RADIATION SICKNESS

1179 The Antibody Response in Cases of Radiation Lymphopenia, and in the Reticuloses, by R. Winston Evans. Journal of Pathology and Bacteriology 60, p. 123-130, January 1948.

The antibody response was tested in a series of 30 patients exhibiting a radiation-induced lymphopenia and in a control group of 17 individuals with a normal blood-lymphocyte level. A suspension of Bact. paratyphosum A(H) was used as antigen. A lower level of antibody production was recorded in patients showing a low lymphocyte count. The significance of this finding is related to the immunological function of the lymphocyte.

A series of reticulo-endothelioses comprising cases of myelocytic and lymphatic leukaemia, Hodgkin's disease, lymphosarcoma and lymphofollicular reticulosis was also tested for agglutinin response, which was found to be very poor except in the myelocytic leukaemias. This poor response is attributed to the degree of disorganization of the lymph glands in these conditions.

1180 Infantile Blood System. Science News Letter 54, p. 146, September 4, 1948.

Following the study of material collected in Nagasaki and Hiroshima, Col. Elbert DeCoursey of Brooke General Hospital, San Antonio, Texas, presented the following findings at a meeting of the International Society of Hematology. Plasma cells of the same type as the cancerous lesions in multiple myelomas are formed when cells in the bone marrow attempt to regenerate after killing doses of radiation. The red blood cells, granulocytes, and lymphocytes were all reduced in number. They return to normal in about 14 weeks, 9 weeks, and 12 weeks, respectively. During the recovery of the red blood cells there is a period about the eighth week when the young blood cells remain in a partially developed state. However, if the affected persons can be kept alive by transfusions into the third month, the blood-forming system begins to work again and the cells begin to mature.

RADIOACTIVITY

1181 The Beta Spectrum of S^{35}, by R. D. Albert and C. S. Wu. AECD-2227 (CUD-8), n.d., decl. August 25, 1948. 6 p. For publication in Physical Review.

Recently results have been published on S^{35} negatrons and both positrons and negatrons from Cu^{64} which show an increase in number over that predicted by the Fermi theory at low energies (Cook et al., Physical Review 73, p. 601, 1948; 73, p. 1395, 1948). Because it is difficult to understand theoretically why such deviations should occur at low energy after the coulomb correction has been made, an attempt was made to check these results with thinner sources.

Using extremely thin sources of S^{35} ($\sim 1 \mu g/cm^2$) in the Columbia solenoid β-ray spectrometer, Fermi plots were obtained showing straight lines from the upper energy limit down to 16 kev. Somewhat thicker sources ($\sim 5 \mu g/cm^2$) showed large deviations from a straight line Fermi Plot — thus emphasizing the importance of using extremely thin sources for low energy measurements. The source backings used were about $3 \mu g/cm^2$ and the counter window weighed less than $30 \mu g/cm^2$.

1182 The Alpha-Particle Energy of Ac^{227}, by A. Ghiorso, J. M. Hollander, and I. Perlman. AECD-2232 (UCRL-151), July 19, 1948, decl. August 25, 1948. 3 p. Informal disposition. Document for sale by AEC.

Using an alpha-particle pulse analyzer, the energy of the Ac^{227} alpha-particle has been measured on material obtained from the pile irradiation of Ra^{226}. The Ac^{227} obtained in this way is free of Pa^{231}. The alpha-particle energy was determined by comparing purified actinium with Ra^{226} (4.791 Mev) and Po^{210} (5.298 Mev) as primary standards. The value obtained was 4.94 (± 0.01) Mev.

RADIOACTIVITY

1183 Properties of Tl^{209}, by French Hagemann. AECD-2233 (ANL-HDY-527), June 18, 1948, decl. August 25, 1948. 8 p. For publication as a letter to the editor of Physical Review.

The product of alpha-disintegration of Bi^{213} would be Tl^{209} (neptunium C'') which, by analogy with the C'' products of the natural radioactive series, should be a beta-emitter with a half-life of only a few minutes. Because of the short half-life of the thallium, a separation method which could be carried out in a relatively short time was necessary. Such a procedure is indicated. A typical decay curve is shown. The half-life as determined by least squares analysis of seven such decay curves was 2.20 minutes, with a probable error of ± 0.07 minutes. An aluminum absorption curve of the Tl^{209} beta particles was obtained.

1184 Evidence for a New Isotope of Potassium, by Roy Overstreet, Louis Jacobson, and P. R. Stout. AECD-2246 (UCRL-155), July 1, 1948, decl. August 31, 1948. 10 p. For publication in a technical journal.

A study of the potassium isotopes produced by the bombardment of argon with helium ions reveals the presence of a hitherto unknown isotope with a 22.4 hour half-life. The new potassium isotope has two beta components of approximately 0.25 Mev and 0.8 Mev maximum energies. A gamma component is present of roughly 0.4 Mev energy. The evidence strongly suggests that the isotope in question is K^{43} produced by the reaction $A^{40}(\alpha,p)K^{43}$.

1185 Half-Life of UX_1 (Th-234), by G. B. Knight and R. L. Macklin. AECD-2260 (K-203), April 1, 1948, decl. September 1, 1948. 3 p. For publication in Physical Review.

This is not an abstract; the document is reproduced below in its entirety.

Introduction: The half-life of UX_1 has recently been redetermined in this laboratory (Carbide and Carbon Chemicals Corporation, Laboratory Division). Several values are reported in the literature including 24.5 days by Curie, et al (Reviews of Modern Physics 3, p. 347, 1931), and more recently 24.1 ± 0.2 days by Sargent (Canadian Journal of Research A 17, p. 103, 1939), in 1939. The present work was undertaken to reduce the uncertainty in this constant and thereby allow a more accurate calculation of the quantities of U-234 grown from sample of UX_1. As a preliminary step, the data of Sargent were reevaluated statistically. The estimate of the half-life arrived at by applying the method of least squares to the logarithms of Sargent's observed activities and associated decay times was 24.03 ± 0.27 days. The error here forms the limits of the 95% confidence belt. The half-life was then redetermined independently.

Sample Preparation: Samples of uranium largely freed of the U-235 and U-234 isotopes and other radioactive contaminants were used as a source of UX_1 for half-life determinations. The UX_1 was isolated after a suitable growth period by precipitating zirconium iodate as a carrier in a uranyl nitrate solution. The first precipitate so formed was dissolved in concentrated hydrochloric acid and a second precipitation then made to further reduce the traces of occluded uranium present. The final precipitate was mounted for counting in a thin film on a one-inch filter paper disk. Two such samples were prepared and counted.

Activity Determination: Two standard thin walled (0.006'') Geiger Counters (Technical Associates Model GS-4 mountings and circuits) were used, each sample being counted on both. The first sample had an initial counting rate of some eleven hundred counts per minute and was counted for seventy one hour periods on each counter during the 1700 hours (3 half-lives) immediately following sample preparation. The second sample had an initial rate near three thousand and was counted for about one-hundred one-hour periods on each counter during the 2200 hours (4 half-lives) immediately following its preparation. A close check on counter sensitivity was maintained by overnight counts of high purity U_3O_8 samples which had had two years to approach equilibrium with UX_1 and UX_2. All sample counts were corrected for counter shift, coincidence losses (never over 1.5%), and background (determined by counting zirconium iodate blanks.)

RADIOACTIVITY

Analysis: The decay curve of each of the four samples was found by the usual method of fitting a least squares line to the collection of points formed by the logarithms of the corrected counting rates with the associated time of measurement of each rate, assuming the time as precisely known. Each point was weighted as the reciprocal of the total variance of its logarithm. From the slope of this least squares line, an estimate of the half-life may be readily computed.

The data for each counter were tested for curvature (the expected effect of a long-lived contaminent such as U-238) in two ways. The deviation of the logarithm of each sample count from its least squares line was calculated and shown not to be preponderantly positive or negative near either the middle or the ends of the period of measurements of the sample. The variances of these deviations were compared, using the F test, with the internally predicted variances. In only one of the four cases did the deviations show a significantly larger variance than that due to the counting statistics. alone.

Using the larger variance in each case the following four estimates of half-life were calculated:

Sample	Counter A	Counter B
1	24.14±0.10 days	24.04±0.07 days
2	24.13±0.04 days	24.09 0.04 days

There being no evidence of significant differences among these values they were averaged and the error of the mean (95% confidence interval limits) determined by propagation of the individual errors. The final value thus arrived at is 24.101±0.025 days. These data support Sargent's earlier data and give a ten-fold decrease in the uncertainty of the half-life of Uranium X_1.

1186 A Search For Gamma Rays From He^6 and F^{18}, by William J. Knox. AECD-2261 (UCRL-159) August 2, 1948, decl. August 31, 1948. 4 p. For publication in Physical Review as a letter to the editor.

The series of beta-active nuclei with (4n + 2) primary particles, He^6, Be^{10}, C^{14}, F^{18}, Na^{22}, etc. has created much discussion because some of its members show allowed transitions while others are forbidden. It seemed possible that the allowed cases might represent transitions to excited states; if so, a consistent rule should govern the transitions to the ground states. However, the results from a search for gamma rays from He^6 and F^{18} seem to exclude this explanation unless the unlikely assumption of a very low energy gamma ray is made.

Absorption measurements on F^{18} have shown a penetrating radiation which has the expected annihilation radiation energy of about 0.5 Mev. In order to exclude further the possibility of a true gamma ray of about 0.5 Mev energy, which would not be detected by half-thickness measurements, absorption curves on F^{18} and C^{11} have been compared to see if the ratio of positrons to photons is the same; C^{11} is assumed to have no gamma ray. The ratio of the number of counts coming from the sample when surrounded by 400 mg/cm^2 of Al to the number of counts extrapolated to zero absorber was observed to be .011 for C^{11} and .010 for F^{18}, both values with a probable error of about 10%. It is concluded that greater than 80% of the positrons from F^{18} represent a transition to the ground state of O^{18}. From absorption measurements of the radiation from He^6 it is concluded that there is no gamma ray associated with the disintegration of the He^6 unless it is of very low energy (< 100 Kev) or of low intensity ($<10\%$)of disintegrations if gamma ray were of 1 Mev).

1187 "Cross-Over Transitions" in Cl^{38}, Co^{60}, Br^{82}, and Sb^{124}, by V. Myers and A. Wattenberg. AECD-2264 (ANL-HDY-534), July 19, 1948, decl. August 31, 1948. 3 p. For publication in Physical Review. (See also AECD-1953).

In Cl^{38}, Co^{60}, Br^{82}, and Sb^{124}, gamma rays are known to be emitted in cascade. An attempt has been made to investigate the frequency of occurrence of "cross- over transitions," namely, the single step process from the initial to the final state. The techniques employed for determining the frequency of occurrence and energy of these gamma rays have been previously described (Wattenberg, Physical

RADIOACTIVITY

Review 71, p. 497, 1947). Threshold reactions of photo-disintegrations of Be^9 and D^2 are used in the detection of these weak, high-energy gamma-rays.

Only in the cases of Br^{82} and Sb^{124} are the results definitely indicative of the cross-over transition. No photoneutrons were observed from Br + D_2O indicating that only two gamma rays are paralleled in the cross-over transition. The neutron yield of Co^{60} was so low that no determination was possible of the energy or of the half-life, and it is not certain that the photoneutrons detected are not associated with a small impurity. In Cl^{38} there is a 4.9 Mev beta-ray branch. The bremsstrahlung from this beta ray gave rise to some photoneutrons so only an upper limit can be set for the cross-over transition. A table is given listing isotope studied, target material, half-life of isotope, photons per disintegration, measured energy, cross-over energies, cascade energies, and transition probabilities. Cross-over energies, Ec, are given as follows: Cl^{38}, 3.75 Mev; Co^{60}, 2.4 Mev; Br^{82}, 2.9 Mev; and Sb^{124}, 2.3 Mev.

1188 The Gamma Rays Following Au^{198} β-Decay, by D. Saxon and R. Heller. AECD-2290 (ANL-HDY-535), July 1948, decl. September 17, 1948. 4 p. Publication in Physical Review as a letter to the editor.

The question whether the decay of Au^{198} is simple or complex has been considered at length in the published literature. In view of recent conflicting measurements, it was decided to rerun the Au spectrum checking carefully for low energy internal conversion lines from the 0.157 and 0.208 Mev gamma rays. The momentum plot of the resulting spectrum is given. The conclusion reached seems to be that the low energy gamma rays are associated with an impurity, and not with the β-decay of Au^{198}. 10 references.

1189 A New Radioactive Series — The Protactinium Series, by Martin H. Studier and Earl K. Hyde. Physical Review 74, 591-600, September 1, 1948. (See also MDDC-1567).

A new series of radioactive isotopes has been produced by deuteron and helium bombardments of thorium in a 60-inch cyclotron. The relation of this protoactinium series to the uranium-radium series is presented. Half-lives and alpha energy peaks were measured. The 5.86 Mev peak was definitely assigned to U^{230}. Other peaks were 6.3 Mev, 6.5 Mev, 7.1 Mev, and 7.7 Mev, but these have not been definitely assigned. Only tentative assignments to the isotopes in the inverse order of their half-lives were made. Thus, the 6.3 Mev alpha particle is assigned to the 30.9 minute Th^{226}, the 6.5 Mev alpha particle to the 38 second Ra^{222}, and the 7.1 Mev alpha particle to the 0.019 second Em^{218}. For the measurement of the short half-life of Em^{218}, a simple electronic device had to be developed.

The decay scheme is:

$$Pa^{230} \xrightarrow[17d]{\beta^-} U^{230} \xrightarrow[20.8d]{\alpha(5.86\ Mev)} Th^{226} \xrightarrow[30.9m]{\alpha(6.3\ Mev)}$$

$$Ra^{222} \xrightarrow[38s]{\alpha(6.5\ Mev)} Em^{218} \xrightarrow[0.019s]{\alpha(7.1\ Mev)} RaC' \xrightarrow[1.5 \times 10^{-4}s]{\alpha}$$

$$RaD \xrightarrow[22y]{\beta^-} RaE \xrightarrow[5d]{\beta^-} RaF \xrightarrow[140d]{\alpha} RaG(stable)$$

1190 Notes on the Beta-Spectra of Y^{90} and Sr^{90}, by Walter E. Meyerhof. Physical Review 74, p. 621-622, September 1, 1948.

The beta-end-point energies of Y^{90} and Sr^{90} were determined using a conventional 180 type spectrometer. A Kurie plot of the beta spectra is given and yields 2.35 ± 0.03 Mev for the Y^{90} end point and 0.61 ± 0.01 for the Sr^{90} end point.

RADIOACTIVITY

1191 Radiations from Platinum (193) and Gold (199), by C. E. Mandeville, M. V. Scherb, and W. B. Keighton. Physical Review 74, p. 601-605, September 1, 1948.

The 4-day platinum activity, Pt^{193}, was induced in metallic platinum irradiated by neutrons in the pile at Oak Ridge. This isotope was found to emit conversion electrons of energy 0.115 Mev and X-rays of energy 70 Kev. Beta-gamma-coincidence measurements showed that the conversion electrons are coupled with little or no gamma-ray energy. Gamma-gamma-coincidences, probably gamma-(X-ray) coincidences, were found in Pt^{193}.

Aluminum absorption gave a maximum energy of 0.38 Mev for the beta rays of the 3.3-day Au^{199}; lead absorption indicated gamma radiation of energy 0.18 Mev. Beta-beta- and beta-gamma-coincidences were present in Au^{199}, but no gamma-gamma-coincidences were found. The absorption and coincidence measurements are combined to construct a disintegration scheme for Au^{199}.

1192 Reported Radioactivity of Osmium, by A. H. W. Aten. Nature 161, p. 1019, June 26, 1948.

It has been reported that Os^{187} is radioactive with a half-life of 3×10^8 years (Lougher and Rowlands, Nature 153, p. 374, 1944). Geophysical data concerning the rhenium content of a number of minerals has caused grave doubt of the view that Os^{187} is radioactive. If disintegration by K-electron capture does take place, the half-life must be several orders of magnitude greater than the one given above.

1193 Study of the Beta-Spectra of C^{14} and S^{35}, by C. Sharp Cook, Lawrence M. Langer, and H. Clay Price, Jr. Physical Review 74, p. 548-552, September 1, 1948.

The shape of the momentum distributions of the negatrons emitted by C^{14} and S^{35} was studied, and information was obtained on the influence of source thickness and backing on the measurement of low energy spectra. A high resolution, 40 cm radius of curvature, magnetic spectrometer was used. Graphs are given showing the effects of source thickness and backing. In the case of S^{35}, the experimental results are in good agreement with theory for all energies above $W=1.15\ mc^2$ up to the end point, $W_O=1.331\ mc^2$. An upper limit can be set on the rest mass of the neutrino from the shape of the S^{35} spectrum in the vicinity of the end point. Within the limits of error, the mass of the neutrino is less than one per cent of m_e.

The shape of the C^{14} spectrum differs slightly from that which would be predicted for an allowed transition and is inconsistent with that calculated for a second forbidden transition. The extrapolated end point for C^{14} is at $W_O=1.306\ mc^2$.

RADIOCHEMISTRY

1194 Radiation Chemistry, by F. S. Dainton. Research 1, p. 486-492, August 1948.

Reactions caused by absorption of nuclear radiation are necessarily more complex than the corresponding photochemical reactions, due to the greater variety and uneven distribution of the products of the primary act. Reliable identification of the nature and number of such products would represent a considerable advance. To achieve this end an alliance of spectrographic and purely chemical methods seems to be necessary. Furthermore, much more extensive data is required concerning the kinetics of the reactions which have been observed in order to place them in the proper category as to type of system. It cannot be doubted that with the necessity to manipulate more and stronger radioactive sources, and with developments in radiotherapeutics, the subject of radiation chemistry is likely to expand rapidly.

RADIOGRAPHY

1195 Autoradiographs of C^{14} Incorporated in Individual Blood Cells, by George A. Boyd; George W. Casarett, Kurt I. Altman, Thomas R. Noonan, and Kurt Salomon. AECD-2277 August 10, 1948, decl. September 13, 1948. 6 p. For publication in Science.

Since Altman et al. (Federation Proceedings 7, p. 2, 1948) demonstrated that the alpha-carbon atom of glycine labeled with C^{14} is incorporated into the hemin and globin moieties of hemoglobin, it was thought that the C^{14} incorporated into blood cells could be demonstrated by autoradiographs. Three μc of glycine containing C^{14} in the alpha-carbon atom (specific activity 1.83 μc/mg.) were injected intraperitoneally into a rat. Venous blood was taken from the tail of this rat 25 hours after injection, diluted with dog blood serum, smeared directly on Eastman NTB emulsion, dried, and fixed. The emulsion plates were exposed 67 days, developed, cleared, and the cells were stained. Autoradiographs resulting from beta emissions from C^{14} incorporated into blood cells were produced on test plates. The frequency of autoradiographs in each cell category, as well as the general concentration of their silver grains, declined in the order: lymphocytes, polymorphonuclear leucocytes, erythrocytes. This is probably the order of increasing life span, and it may be expected that the percentage of new cells of each type in normal peripheral rat blood at a given time would decrease in the same order. The concentration of silver grains appears to be generally greater with those types of cell containing relatively larger amounts of nuclear material.

RADIOTHERAPY

1196 Methods of Therapy of Skin Cancer, by Charles Lerner. Journal of Investigative Dermatology 11, p. 89, July 1948.

The author suggests that the use of radioactive phosphorus may yet prove to be of considerable worth in the therapy of skin cancer.

1197 Radioactive Phosphorus (P^{32}) Therapy in Blood Dyscrasias, by Bruce R. Brown. Bulletin of the New England Medical Center 10, p. 185-190, August 1948.

This paper points out that radioactive phosphorus has a rather limited application in the treatment of blood dyscrasias. It has no useful effect in Hodgkin's disease, multiple myeloma, lymphomas, and acute leukemias. It is useful in the treatment of polycythemia vera, chronic myelogenous leukemia, and chronic lymphatic leukemia, but it is in no way curative. It has not radically changed the treatment of blood dyscrasias although preliminary investigations had given rise to much optimism as to its clinical use. 7 references.

1198 Unusual Remission after Radiophosphorus Therapy in a Case of "Acute Plasma Cell Leukemia," by Edwin D. Bayrd and Byron E. Hall. Blood, the Journal of Hematology 3, p. 1019-1023, September 1948.

A 59-year-old man suffering from "acute plasma cell leukemia" was treated with a total of 1,770,000 units of penicillin, 3,000 cc. of whole blood, and biweekly intravenous injections of radiophosphorus, P^{32}, to the amount of 6,135 microcuries. To these authors plasma cell leukemia merely represents a phase or extension of multiple myeloma. Seventeen days after the patient was admitted to the hospital, his condition appeared to be in the terminal stage. However, 31 days later he was allowed to leave the hospital. A year later no evidence of his disease could be found. The authors know of no previously recorded case in the literature of such a remission, either spontaneous or induced. The results from the use of radiophosphorus in the treatment of multiple myeloma have been generally discouraging. This case suggests that radiophosphorus may have a definite usefulness as a therapeutic agent. 4 references.

RADIOTHERAPY

1199 The Use of Radioactive Isotopes in Diagnosis and Therapy, by J. R. Maxfield, Jr., and Jack G. S. Maxfield. Texas State Medical Journal 43, p. 558-562, January 1948.

There is one disease, polychthemia vera, in which radioactive phosphorus is the treatment of choice today. There is one disease, thyrotoxicosis, in which radioactive iodine is an acceptable method of therapy and probably will be used in more than 50 per cent of the cases in the future. Chronic leukemias respond well to radioactive phosphorus, which probably is the best method of treatment available today and certainly is as good as any other method now available. The treatment of carcinomas of the thyroid by radioactive iodine is a valuable adjunct for palliative treatment and possible cure in some patients. The use of certain radioactive colloids offers a chance of palliative management of malignant conditions as above mentioned. Certain skin lesions can be adequately treated by radioactive materials applied on blotting paper. The future seems bright for the use of radioactive isotopes in diagnosis and treatment.

RADON

1200 Radon, Its Technique and Use, by W. A. Jennings. London, John Murray, 1948. 222 p.

This book has been written as a book of reference; the technique is treated in detail. The book is divided into three parts; an appendix gives an extract from the "Recommendations of the British X-ray and Radium Protection Committee", and another appendix concerns the design of a national radon centre.

RARE EARTHS

1201 The Chemical Isolation of Samarium from Lanthanide Mixtures, by A. F. Clifford and H. C. Beachell. Journal of the American Chemical Society 70, p. 2730-2731, August 1948.

Samarium has been separated from the other rare earth elements (except europium and yttrium) by reduction of ethanolic solutions of rare earth trichlorides with magnesium and hydrochloric acid (aqueous or anhydrous), yielding red samarium dichloride, $SaCl_2$. Using aqueous hydrochloric acid and diluting with dioxane, even from very low samarium concentrations green samarous hydroxide is produced directly instead. This reaction may be of significance for qualitative detection of samarium. By metathesis of the dichloride, the sulfate, hydroxide, citrate, carbonate and fluoride, all water-insoluble, have been prepared. The poisoning effect of iron and particularly platinum on the reduction is noted. In neutral ethanolic solution, samarous chloride was precipitated by magnesium amalgam. The reaction, however, was complicated by hydroxide precipitates. In neutral aqueous sulfate solution, samarous sulfate was likewise precipitated by magnesium amalgam, with the same complications. Addition of a little methanol in the last case aided the reaction. The potential for the samarous-samaric couple in ethanolic chloride solutions has been placed in the region of 1.9-2 3 v.

1202 An Investigation of Samarium and Gadolinium by the Photographic Method, by K. K. Keller and K. B. Mather. Physical Review 74, p. 624-625, September 1, 1948.

Photographic plates impregnated with $Sm(NO_3)_3$ show that if there are long-range particles from Sm they number less than 0.4 per cent of the short alpha tracks. No evidence for proton emission is noted.

Plates impregnated with Gd_2O_3 show that the stopping power of the emulsion is not altered appreciably by the introduction of the Gd. The half-life of Gd^{152} is seen to be greater than 10^{15} years. Using a pure Gd isotope, the upper limit of half-life which could be detected by a resonable amount of scanning is probably of the order of 10^{20} years.

RARE EARTHS

1203 The Radioactive Lanthanum and Cerium Isotopes of Mass 137, by M. G. Inghram and D. C. Hess, Jr. Physical Review 74, p. 627, September 1, 1948. (See also AECD-2115).

A sample of CeO_2, submitted to long neutron bombardment, consisted of 30.6-day Ce^{141}, 1.4-day Ce^{143}, and 13.5-day Pr^{143}. The isotope observed at mass 137 is lanthanum which has been formed by radioactive decay of Ce^{137}. The half-life of Ce^{137} is seen to be less than two weeks and that of La^{137} greater than thirty years.

1204 Some Analytical Applications of m-Nitrobenzoic Acid with Particular Reference to the Separation of Quadrivalent Elements from the Rare Earths (Lanthanides), by G. H. Osborn. Analyst 73, p. 381-384, July 1948.

Some reactions of m-nitrobenzoic acid have been re-examined and it has been found that the reagent reacts quantitatively, under strictly controlled conditions, with thorium, zirconium, cerium IV, hafnium and mercury. Harvey et al (Journal of the Chemical Society 1947, p. 1010) have shown that quadrivalent plutonium reacts similarly. The reagent does not react with the tervalent rare earths (lanthanides series) examined, and doubts are, therefore, cast on the reported reaction with erbium. Apart from possible interference due to hydrolysis of certain tin salts and by the presence of mercury, the reagent appears to be a specific precipitant for all quadrivalent metals except titanium. Conditions are described under which most of the elements found to react can be separated from each other.

SCIENTIFIC RESEARCH

1205 Report of Scientific Director on Cooperation in Effort at Eniwetok, by Darol Froman. AECD-2257 (LADC-528), May 21, 1948, decl. September 1, 1948. 5 p. For publication in Review of Scientific Instruments.

Organizations and individuals concerned with collecting data at the Eniwetok Atoll proving ground for atomic weapons are listed.

1206 AEC Aids in Research on Radioactive Tracers. Engineering and Mining Journal 149, No. 9, p. 103, September 1948.

Under a grant of the Atomic Energy Commission, Massachusetts Institute of Technology is expanding its research in the department of metallurgy on the application of radioactive tracer techniques to mineral engineering problems.

1207 Swiss Work in Nuclear Physics. Chemical Age 59, p. 293, August 28, 1948.

Experiments have been taking place for some time in Switzerland, chiefly at the Federal Technical Institute (ETH) in Zurich and at Basle University, concerning the technical utilization of the heat produced in nuclear reactions. A betatron of 30 megavolts has been constructed in order to carry out radiation experiments. It is intended to construct further betatrons for therapeutical purposes.

SPECTROSCOPY

1208 The Spectrochemical Determination of Hafnium-Zirconium Ratios, by Cyrus Feldman. AECD-2285, n.d., decl. September 9, 1948. 1 p. For publication in Program of the Optical Society of America, in connection with the meeting to be held in Detroit, Mich., October 21-23, 1948.

This document is an abstract; it is reproduced below in its entirety.

A spectrochemical technique is presented for determining hafnium-zirconium ratios in the range (Hf x 100)/Zr = 0.065 – 8.0 by weight, with an without the aid of hafnium-free zirconium preparations. The sample is brought into solution in 10% H_2SO_4 and sparked by the porous cup technique. The intensity ratio Hf II 2641.406/Zr II 2761.911 is measured, and the Hf/Zr ratio read from a standard curve.

SPECTROSCOPY

1209 A New Industrial Infra-Red Spectrometer, by R. R. Gordon, H. Powell, and R. A. C. Isbell. Journal of Scientific Instruments and of Physics in Industry 25, p. 277-282, August 1948.

Quantitative analysis by means of infra-red absorption methods has been limited in the past by having to calibrate each spectrometer for the materials on whose analysis it is to be used. It is shown that in the case of two spectrometers of nominally the same design, identical calibration curves of optical density versus concentration are obtained only when corrections are made for cell zero and scattered radiation. The effects of making these corrections are illustrated by the calibration curves for isobutane, n-butane and cyclohexane as determined on two instruments of identical design. The problem of correlating spectrometers of differing design is also discussed. A detailed description is given of an industrial infra-red spectrometer.

1210 Relative gf-Values for Lines of Ni I, by Robert B. King. Astrophysical Journal 108, p. 87-91, July 1948.

The relative gf-values for 134 lines in the spectrum of Ni I $\lambda\lambda$ 3012-3912 have been obtained from electric-furnace absorption spectra. All the lines arise from the three lowest terms, a^3F, a^3D, a^1D. The furnace gf-values are compared with arc-intensity measurements published by other investigators.

TRACER APPLICATIONS

1211 Determination of Position of Tracer Atom in a Molecule: Mass Spectra of Some Deuterated Hydrocarbons, by John Turkevich, Lewis Friedman, Ernest Solomon, and Frances M. Wrightson. Journal of the American Chemical Society 70, p. 2638-2643, August 1948.

Since the mass spectrum of a molecule consists of fragment ions obtained by rupture of valence bonds it was thought that the relative abundance of appropriate ions would indicate the position of an isotopic atom. The purpose of this study was to establish the validity of this concept and to study in general the changes in the mass spectrographic pattern of hydrocarbons produced by replacing some of the hydrogens with deuterium. With this in mind monodeuteromethane, tetradeuteromethane, monodeuteroethane, monodeuteropropane-1 and monodeuteropropane-2 were synthesized and their mass spectra determined on a Nier type and a Consolidated mass spectrometer. A method of calculating the mass spectrum of monodeuteromethane and monodeuteroethane from the corresponding light hydrogen compounds, was investigated. A method has been given to indicate the position of a deuterium atom in monodeuteropropanes.

TRACER APPLICATIONS, RADIOACTIVE

1212 Studies of the Kinetics of Potassium Exchange between Cells and Plasma of Canine Blood in Vitro Using K^{42}, by C. W. Sheppard and W. R. Martin. AECD-2249, August 12, 1948, decl. August 26, 1948. 23 p. For oral presentation before a meeting of the Society of General Physiologists to be held at Woods Hole, Massachusetts, September 8-10, 1948.

Freshly-drawn heparinized canine whole blood is equilibrated in vitro (paraffin lined vessels) at 38.1°C with a normal pulmonary atmosphere saturated with water vapor. It is then tagged by mixing with a small amount of plasma containing dextrose and radioactive KCl. The potassium content of the resulting plasma is thus raised by not more than 3% of the normal and the blood sugar to about 400 mg%. By this procedure cells are maintained in a healthy state for periods up to 10 hours as shown by minimal hemolysis, nearly constant hematocrit and minimal potassium leakage.

In whole blood the activity of the plasma decreases initally at a rapid rate which is correlated with the appearance of activity in the cells (red cells, white cells, and platelets). The initial decrease

follows an exponential curve to an elevated base line, half of this change being complete in about 50 minutes. However, if the white cells and platelets are previously removed by repeated differential centrifugation, the behavior is different. The plasma activity declines very slowly, at the rate of about 1% per hour.

The initial rapid decrease in plasma activity for whole blood is attributed to a rapid exchange of potassium in the fraction containing the white cells and platelets. A typical value for the amount of this easily exchangeable potassium is about 30% of the total potassium in the plasma. It is evident that studies of potassium exchange of erythrocytes must give equivocal results unless the white cells and platelets are removed in advance or otherwise taken into account. 10 references.

1213 An Isotope Effect in a Simple Chemical Reaction, by Peter E. Yankwich, Melvin Calvin. AECD-2293 (UCRL-145). July 13, 1948, decl. September 17, 1948. 7 p. Publication in Journal of the American Chemical Society.

The decarboxylation of malonic acid in which one carboxyl group is labeled with C^{14} has been studied. It was found that the CO_2 formed is impoverished in C^{14} while the acetic acid formed is correspondingly enriched. A detailed procedure is given for the study of the reaction.

1214 Distribution of Radioactive Carbon Among Certain Amino Acids of Liver Homogenate Protein, Following Uptake Experiments with Labelled Glycine, by Theodore Winnick, Ingrid Moring-Claesson, and David M. Greenberg. Journal of Biological Chemistry 175, p. 127-132, August 1948.

Radioactive protein, derived from incubation of liver homogenate with C^{14}-labelled glycine, was hydrolyzed and subjected to analysis. Amino acid isolation experiments with non-radioactive carriers indicated that only 11 to 12 per cent of the C^{14} in the protein was due to glycine itself. The major portion, approximately 60 per cent, of the isotopic carbon was found in serine, derived from the glycine. Low concentrations of C^{14} were found in glutamic and aspartic acids and in arginine. Alanine contained no C^{14}.

1215 The Utilization of Labeled Glycine in the Process of Amino Acid Incorporation by the Protein of Liver Homogenate, by Theodore Winnick, Felix Friedberg, and David M. Greenberg. Journal of Biological Chemistry 175, p. 117-126, August 1948.

The incorporation of C^{14} into the protein of cell-free homogenates of rat liver has been observed, following incubation with labeled glycine at 37° in an oxygen atmosphere. The process appears to be enzymic in nature. It is inhibited by heat, cyanide, azide, and anaerobic conditions. The rate of incorporation of C^{14} is dependent upon the glycine concentration, time of reaction, and pH of the medium. The enzyme system which promotes the utilization of the C^{14} of glycine is associated with the insoluble particles of the homogenate. The process is promoted by certain inorganic ions: magnesium, phosphate, potassium, and particularly calcium. Of a number of organic substances tested, glucose and citrate exerted a slight stimulatory effect. Adenosine triphosphate, cytochrome, phridoxal, and cozymase, on the contrary, caused a slight inhibition.

Very recently there was obtained a several fold increase in the rate of C^{14} incorporation by reducing the volume of the incubation mixture of 0.33 ml without altering the amount of homogenized liver or liver particles customarily employed. Concentrated particles are about 3 times as active as liver slices, and since smaller amounts of labeled glycine (0.03 mg.) are employed, the efficiency is such that approximately 10 per cent of the C^{14} is incorporated within 1 hour.

TRACER APPLICATIONS, RADIOACTIVE

1216 The Distribution of Radioactivity in the Mouse Following Administration of Dibenzanthracene Labeled in the 9 and 10 Positions with Carbon 14, by Charles Heidelberger and Hardin B. Jones. Cancer 1, p. 252-260, July 1948. (See also AECD-1922).

Dibenzanthracene, labeled in the 9 and 10 positions with C^{14}, was given to mice intravenously and by stomach tube as an aqueous colloid, and intraperitoneally, subcutaneously, and by stomach tube in tricaprylin solution. The colloid solution was given intravenously in injections of 0.42 and 0.341 mg and in doses of 0.530 and 0.380 mg by stomach tube. The doses of dibenzanthracene in tricaprylin were 0.517 and 0.452 mg by stomach tube, and 1.0 mg per 0.30 cc tricaprylin intraperitoneally. The amount of subcutaneous injection is not given. After intervals ranging from one-half hour to seven days the mice were sacrificed, dissected, and burned in oxygen in a standard combustion train. Following an intravenous injection of 0.5 mg of the colloidal solution, 89 per cent of the dose was found in the liver after a half-hour interval, 82 per cent after one and a half hours, and 3.5 per cent after 24 hours. During these intervals the intestinal contents and feces percentages of the dose were 1.9, 7.6, and 94.0. At the end of 24 hours the spleen, plasma, and red cells had lost all they had absorbed and the lung content had dropped from 0.43 to 0.37 per cent. The experiments showed that radioactive substances are rapidly eliminated, mainly through the feces, and that very little material is absorbed by the tissues. The most rapid elimination follows administration by stomach tube and the slowest follows subcutaneous injections. Forty-eight hours after administration by stomach tube, only 0.9 per cent of the total dose could be detected, but 2.2 per cent could be detected 8 weeks after subcutaneous injection.

Whether the dibenzanthracene is administered as a colloid or in tricaprylin, there is little difference in its fate. There seems to be no apparent tendency for the substance to concentrate within a short period of time in neoplasms already present in the animal, but an appreciable quantity of radioactivity was found in tumors caused several months after a single cutaneous injection of dibenzanthracene. The authors emphasize the idea that there is absolutely no justification in assuming that the radioactivities found in this study represent unchanged dibenzanthracene. They may show merely the presence of the carbon atoms originally situated in the carcinogen, which may have been changed to completely different compounds by the time the assays are made. It is also emphasized that the results of this work do not contradict earlier work in the field, but that the labeled carbon atom technique simplifies the probelm of recovering the administered doses, and permits much greater recovery — 98.8 per cent against approximately 33.3 with older methods. 21 references.

1217 On the Mechanism of Action of Muscle and Potato Phosphorylase, by Mildred Cohn and Gerty T. Cori. Journal of Biological Chemistry 175, p. 89-93, August 1948.

No exchange occurred between inorganic phosphate and glucose-1-phosphate in the presence of muscle phosphorylase a or potato phosphorylase in the absence of polysaccharide as acceptor. Furthermore the phosphate of adenylic acid did not interchange in a complete reaction mixture containing inorganic phosphate (P^{32}), glucose-1-phosphate, glycogen and muscle phosphorylase b. The possibility of an exchange between glucose (labeled with C^{14}) and glucose-1-phosphate was investigated in the presence of muscle phosphorylase and was found to be negative. The implications of these results are discussed in so far as they affect the mechanism of these enzyme reactions.

TRANSURANIC ELEMENTS

1218 The Dependence of the Heat of Solution of Plutonium Trichloride on the Concentration of Hydrochloric Acid, by Herman P. Robinson and Edgar F. Westrum, Jr. AECD-2238 (ANL-JJK-14B-149), June 1948, decl. August 24, 1948. 6 p. For inclusion in NNES.

The heat of solution (reaction) of $PuCl_3$ has been measured at 25°C in HCl of concentrations 0.1, 1.5, 6, 9, and 11.4 molar. The heat of solution of $PuCl_3$ in infinitely dilute HCl has been found by

TRANSURANIC ELEMENTS

extrapolation to be -31.9 kcal mole^{-1} and the heat of formation of Pu(III) ion calculated as -141.5 kcal mole^{-1}. The heat of solution of $PuCl_3$ in 1.5 molar hydrochloric acid was measured as part of a sequence of reactions to determine the heat of formation of PuF_3. A value in more dilute acid was desirable to extrapolate the heat of solution to infinite dilution of the acid. 14 references.

1219 Note on the Reaction of PuF_3 with Dry Oxygen, by B. M. Abrahm and N. R. Davidson. AECD-2241 (ANL-JJK-14B-82), May 1945, decl. August 26, 1948. 7 p. For inclusion in NNES.

An attempt to measure the equilibrium oxygen pressure over a PuF_4, PuO_2 mixture due to the reaction, $3PuF_4 + PuO_2 \longrightarrow 4PuF_3 + O_2$, was unsuccessful. Heating at 600°C to 800°C developed only approximately 2mm of Hg of oxygen pressure, and there was considerable sublimation of a plutonium compound. Chemical analysis of the residue indicated that it was primarily PuF_4.

It was observed that the reverse reaction begins at 300°C when oxygen was present at a pressure of 37 mm of Hg. On the basis of thermodynamic considerations, an inconsistency is pointed out in the observations on the following three reactions: (1) $PuF_4 \longrightarrow PuF_3 + \frac{1}{2}F_2$ which is reported to proceed at an appreciable rate at 1000°C in vacuo. (2) $4PuF_3 + O_2 \longrightarrow 3PuF_4 + PuO_2$, which is reported to proceed at 600°C in the presence of one atmosphere of oxygen. (3) $PuO_2 + 4HF \longrightarrow PuF_4 + 2H_2O$, which is reported to proceed on the gram scale at 600°C.

1220 The Spectrum of Plutonium, by H. W. Dodgen, J. Chrisney, and G. K. Rollefson. AECD-2256 (ANL-JJK-14B-24), n.d., decl. September 1, 1948. 17 p. For inclusion in NNES.

The spectrum of plutonium was investigated using a 20 microgram sample mounted on silver electrodes, and a 0.5 mg sample on copper electrodes. Eastman spectrographic plates were used to photograph the spectral lines. The range of wave lengths covered was from 2100 to 7240A with the exception of five narrow intervals. In Table 1, the lines which were considered definitely characteristic of plutonium are listed. An intensity number assigned each spectral line attempts to indicate qualitatively the appearance of the line on the plate. The lines listed in Table 2 are uncertain because of extreme faintness (0 on the intensity scale) or because of proximity to a strong line in the background spectrum. However, most of these lines are probably characteristic of plutonium.

1221 Computed Values of X-Ray Lines and Limits For the Trans-Uranic Elements, by Ardis T. Monk, and Samuel K. Allison. AECD-2263 (CP-2120), September 6, 1944, decl. August 3, 1948. 10 p. For inclusion in NNES.

For the elements with atomic numbers 83(Bi), 88(Ra), 89(Ac), 90(Pa), 92(U), 93(Np), 94(Pu), 95(Am), and 96(Cm) the following tables are given: (1) Wave number/R values for energy levels K, L_I, L_{II}, L_{III}, M_I, M_{II}, M_{III}, M_{IV}, and M_V; (2) Wave lengths of critical absorption limits in x-units (10^{-11}cm) for energy levels listed above; (3) critical excitation voltages in kilovolts for K, L_I, L_{II}, L_{III}, M_I, and M_V; (4) levels which must be excited to produce various emission lines; (5) wave lengths in x-units and intensities of emission lines in the K series; (6) Wave length in x-units and intensities of some emission lines in the L series; (7) first order glancing angles from calcite and rock salts for critical absorption wave lengths; (8) first order glancing angles from calcite and rock salt for emission lines in the K series; (9) first order glancing angles from calcite for certain L series lines; and (10) first order glancing angles from rock salt for certain L series lines. The methods of computing these various values are discussed.

1222 Preparation of Crystalline Plutonium(IV) Phosphate, by Clifford Smith. AECD-2266 (ANL-JJK-14B-48), May 1947, decl. September 1, 1948. 1 p. For inclusion in NNES.

This is not an abstract; the document is reproduced below in its entirety.

TRANSURANIC ELEMENTS

To a 3 ml pyrex cone which contained about 0.27 ml of 0.015 M Pu(IV) solution in molar nitric acid, was added 15 microliters of concentrated sulfuric acid and 50 microliters of 7 M phosphoric acid. The solution was diluted to 0.40 ml and the cone sealed off. Digestion for two weeks at 70°-95°C resulted in the formation of a light brown crystalline material which was suitable for x-ray diffraction study when suspended in the mother liquor inside a fine capillary. Dr. Mooney reported that this plutonium(IV) phosphate was isomorphous with $Th_3(PO_4) \cdot xH_2O$ and $Ce_3(PO_4) \cdot xH_2O$ (CN-1733, p. 4, May 25, 1944). The crystal structure of this plutonium phosphate may not be representative of the most stable structure at lower temperatures.

URANIUM

1223 Determination of the Surface Area of Uranium Compounds of Different Particle Sizes by Low Temperature Van der Waals Adsorption of Ethane, by Kenneth Lauterbach, Sidney Laskin, and Leonard Leach. AECD-2244 (UR-40), n.d., decl. August 3, 1948. 22 p. For publication in NNES and in Journal of Industrial Hygiene and Toxicology or Industrial and Engineering Chemistry (Analytical Edition).

In order to extend the scope of information on the physico-chemical properties of uranium dusts, surface area measurements have been made on several representative uranium compounds. The experimental method most suitable to the purpose was found to be the low-temperature gas adsorption method. Using a modified form of the apparatus developed by Wooten and Brown, ethane (at −183°C) was chosen as the adsorbate in order to evaluate the very small surface areas encountered. Adsorption isotherms obtained with ethane were found to be similar to the typical sigmoid isotherms described in the literature when nitrogen and other gases were used.

A method was developed enabling the calculation of the theoretical surface of the material from optically measured median particle diameters, weighted in terms both of mass and surface. The ratio of the experimental and the calculated specific surfaces for each sample was then taken as a measure of the relative porosity of the material. The ethane adsorption method was found to be accurate for surface values as low as 10 cm^2, using the blank sample tube as the area for determination. The gas adsorption method was also cross-checked against the method of calculating specific surface for particle size measurements using microscopic glass beads. The two methods yielded specific surface values which differed by an average value of only 8.7%.

The uranium compounds investigated were the dioxide, trioxide, peroxide, tetrafluoride, and the nitrate. With the exception of the peroxide, all of these compounds exhibited fairly low specific surfaces of the order of from 0.4 to 0.7 m^2/g. Corresponding specific surfaces determined from direct microscopic measurements showed a similar range of values. By ethane adsorption the specific surface of the uranium peroxide, however, was found to be 5.74 m^2/g, whereas the calculated value was only 0.49 m^2/g. A porosity value of 11.7 was thus obtained indicating a significant surface irregularity.

Specific surface determinations were also carried out on two solid samples which were obtained by drying aqueous suspensions of fine and coarse uranium dioxide dust. The fine material showed a 10-fold larger area of 4.23 m^2/g as compared with 0.47 m^2/g for the coarse suspension. The corresponding calculated specific surfaces, however, showed only a 5-fold larger area for the fine suspension. This difference and the relatively high porosity values of 14.1 for the fine suspension and 6.8 for the coarse suspension indicate a change in the physical structure of the material or a leaching of the surface associated with the process of preparing this suspension. These results are similar to the findings on increased surface areas associated with the washing of sized glass beads reported in the literature. 15 references.

URANIUM

1224 The System Uranium-Nitrogen, by R. E. Rundle, N. C. Baenziger, A. S. Newton, A. H. Daane, T. A. Butler, I. B. Johns, W. Tucker, and P. Figard. AECD-2247, n.d., decl. January 23, 1948. 22 p. For publication in NNES.

The uranium-nitrogen system has been subjected to chemical and X-ray study. The results of these studies are summarized below. The uranium nitrides are UN, U_2N_3, and UN_2. Nitrides of compositions between U_2N_3 and UN_2 exist as single phases of intermediate structure. Reaction of oxide-free uranium metal or uranium hydride with nitrogen or ammonia at elevated temperatures and ordinary pressures produces a nitride of approximate composition $UN_{1.75}$. This nitride can be reduced by hydrogen to U_2N_3. The higher nitride, UN_2, can be obtained only at high pressures (about 1800 psi). The mono-nitride can be obtained from any higher nitride by thermal decomposition above 1300°C.

Uranium dinitride has the fluorite structure, while U_2N_3 has the closely related Mn_2O_3 structure, and phases of intermediate composition have intermediate structures. The volume decreases with increased nitrogen content within the composition range U_2N_3 to UN_2. Uranium mononitride has the sodium chloride structure. Solid solubilities in the two phase area from metal to UN and from UN to U_2N_3, have been studied at room temperature by X-ray diffraction. Solid solubilities appear to be very slight in both regions. 15 references.

1225 The System Uranyl Sulfate - Water. Part II. Temperature - Concentration Relationships above 250°C, by C. H. Secoy. AECD-2265 (ORNL-98), July 7, 1948, decl. September 1, 1948. 11 p. For oral presentation at the 114th National Meeting of the American Chemical Society held in Portland, Oregon, September 13-17, 1948, and for publication in Journal of the American Chemical Society.

An apparatus for the study of the solubility of salts in water to temperatures above the critical point of water is briefly described. The solubility of $UO_2SO_4 \cdot H_2O$, the stable solid phase in this region, has been followed from 181° to 375°C. Its solubility decreases with rising temperature to about 240° and increases above this temperature. Solutions with a concentration below 82.7% UO_2SO_4 display a two liquid phase region below the critical temperature of water. This phenomena has heretofore not been reported for solutions of electrolytes. Both arms of the curve bounding the two liquid-phase region are followed to the critical temperature of water. The solubility of the salt in water has very nearly reached zero at 350° and, since the aqueous phase always undergoes the critical change at 374.4° (the critical temperature of pure water), it must have reached zero at or below this temperature. The lower critical solution temperature of the two-liquid phase region is 294° and the critical concentration is 30% UO_2SO_4.

1226 A Spectrochemical Method for the Determination of Uranium, by L. T. Steadman. AECD-2267 (UR-41), August 10, 1948, decl. September 1, 1948. 57 p. Oral presentation before a meeting of the Optical Society of America to be held in Detroit, Michigan; for publication in Journal of Industrial Hygiene and Toxicology, and for inclusion in NNES.

A spectrochemical method for the analytical measurement of uranium is described which is applicable to various source materials including animal tissues and fluids, ores, soil, and vegetation. A direct-current carbon-arc method is employed with a medium quartz spectrograph. The uranium may be isolated and concentrated by an ether-extraction procedure. The range of measurement is 0.05 to 10 micrograms of uranium on the arc. The standard error is about ±15%.

1227 The Microfluorometric Determination of Uranium, by George R. Price, Renato J. Ferretti, and Samuel Schwartz. AECD-2282 (CC-2985) June 1945, decl. September 14, 1948. 52 p. Informal disposition. Document for sale by AEC.

A rapid and extremely sensitive procedure is described for the microdetermination of uranium without recourse to preliminary purification. It is based on the measurement of fluorescent light emitted by uranium in fused sodium fluoride irradiated with ultraviolet light. A photoelectric photometer

URANIUM

which has been devised for this purpose is sensitive to the fluoresence from 1×10^{-11} grams of uranium or less. Other factors, however, still prevent accurate determination of amounts less than about 5×10^{-10} grams. Experimental data is presented which shows that the method is applicable to both biological and inorganic material in the presence of even large amounts of quenching impurity. In addition, a theoretical formulation of the quenching process is presented. This agrees with the experimental data in demonstrating that quenching, under the conditions of the method, is a function of the ratio of quencher to sodium fluoride only; it is independent of the ratios of either uranium to sodium fluoride or of uranium to quencher. The procedure has been applied to the study of urine uranium excretion in project personnel. The results show very satisfactory correlation with uranium exposure histories. 43 references.

1228 The Heats of Vaporization of Uranium Hexafluoride, by Joseph Masi. AECD-2288, n.d., decl. September 16, 1948. 20 p. For publication in Journal of Chemical Physics.

Vaporizations of uranium hexafluoride were carried out in a heavy-wall, nickel-plated calorimeter. Measurements of the heat of vaporization of the solid were made at seven temperatures and of the liquid at four temperatures, covering the range from 4° to 90°C. The apparatus was tested before beginning the measurements by obtaining the heats of vaporization of water at three temperatures. The scattering of the data observed for UF_6 is about one per cent. Vapor pressure equations and an equation of state for the saturated vapor have been obtained by correlating the results with the vapor pressure data, heat of fusion, and triple point given in the literature. From these equations and the National Bureau of Standards values for the thermodynamic properties of the solid and liquid, the entropies of the ideal gas are calculated and compared with those given in the literature from spectroscopic data and molecular structure. A diagram of the heat of vaporization apparatus is given.

1229 The Bombardment of U^{233} with 44 Mev Helium Ions and the Formation of Pu^{234}, by I. Perlman, P. R. O'Connor, and L. O. Morgan. AECD-2289 (ANL-JJK-14B-63), n.d., decl. September 10, 1948. 8 p. For inclusion in NNES.

The isotope Pu^{234} has been identified as a product of the bombardment of U^{233} with 44 Mev helium ions. Its mass assignment was made by the identification of members of the U^{230} series following its decay. The Pu^{234} has a half-life of 8-9 hours and decays by orbital electron capture and alpha-particle emission in the ratio 100/1. The alpha particles from Pu^{234} have a range of 4.9 ± 0.1 cm of air at 15°C and 760 mm Hg (6.2 Mev).

The isotopes Pu^{236} and Np^{234} were also observed as products of the 44 Mev helium ion bombardment of U^{233}. The reactions forming the observed isotopes and the cross sections for these reactions are:

$U^{233}(\alpha,n)\ Pu^{236}$	0.0005×10^{-24} cm^2
$U^{233}(\alpha,3n)\ Pu^{234}$	0.001×10^{-24} cm^2
$U^{233}(\alpha,p2n)\ Np^{234}$	0.0002×10^{-24} cm^2

1230 On the Theory of the Mass Distribution Function of the Fission Fragments from Spontaneous Disintegrations, by E. Bagge, Zeitschrift für Naturforschung 2A, p. 565-568, October 1947. (In German).

A theory is developed which accounts for the spontaneous fission of the uranium atom into unequal fragments. A formula for the penetration of the potential barrier leading to fission is given which contains the reduced mass of the two particles; it is therefore sensitive to their mass ratio. Splitting into equal parts is least likely, while the Coulomb forces prevent splitting into parts of widely different masses. The maximum probability is in the mass range given by experiments.

VACUUM

1231 A Highly Sensitive Differential Manometer, by Harry Matheson and Murray Eden. Review of Scientific Instruments 19, p. 502-506, August 1948.

This paper describes the construction and performance of a differential manometer with a sensitivity of 0.001 mm of mercury over the range of absolute pressures from 1 mm of mercury to 1 atmosphere. The sensitive element employed is a pair of nesting diaphragms, displacement of which is measured by the resistive unbalance of an unbonded electrical displacement gauge to which the diaphragms are attached. Calibrations are presented for the sensitivity at one and 10-milliampere gauge current. Data are presented which indicate the operating characteristics under varying conditions of absolute pressure, temperature, gauge current, and geometric orientation.

1232 Vacuum Systems, Seals, and Valves, by Franz N. D. Kurie. Review of Scientific Instruments 19, p. 485-493, August 1948.

This paper is concerned with certain aspects of the technique of all-metal kinetic vacuum systems which have proven their reliability. A brief account is given of the constitution of a system to operate down to pressures of the order of 10^{-5} mm. Precautions to be observed in assembling such a system and in its general care and maintenance are discussed. In all systems reliable, high speed valves are needed. Some which are quite satisfactory for many uses are available. In the event that it is necessary to construct such a valve, a modification of a standard brass gate valve is described. The problem of rubber gaskets is discussed in some detail, and suggestions are made which may relieve some of the difficulties which are occasionally encountered with them. The attention of experimenters is called to the usefullness of O-rings and a number of examples of their use is given.